

THE LANCET & THE HYDERABAD
COMMISSIONS ON CHLOROFORM.



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THE LANCET AND THE HYDERABAD COMMISSIONS
ON CHLOROFORM.

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THE LANCET AND THE HYDERABAD COMMISSIONS ON CHLOROFORM

*BEING THE REPORT OF THE LANCET COMMISSION APPOINTED TO INVESTIGATE THE SUBJECT
OF THE ADMINISTRATION OF CHLOROFORM AND OTHER ANÆSTHETICS FROM A
CLINICAL STANDPOINT, TOGETHER WITH THE REPORTS OF THE FIRST
AND SECOND HYDERABAD CHLOROFORM COMMISSIONS.*

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PREFATORY NOTE

BY THE EDITORS OF THE LANCET.

THE present Volume is a reproduction of the Hyderabad Commissions on Chloroform and of the Report of the Commission appointed by us to Investigate the subject of the Administration of Chloroform and other Anæsthetics from a Clinical Standpoint, and published in THE LANCET in 1893, with the view of supplementing the work of the Second Hyderabad Chloroform Commission, which investigated the question experimentally. Dr. Lauder Brunton, F.R.S., represented THE LANCET at the Second Hyderabad Commission, and the able Report which he assisted to draw up appeared in the columns of THE LANCET in 1890. Many thanks are due from us to Dr. Lauder Brunton for his services on this occasion and subsequently.

Dr. Dudley Buxton undertook at our request the task of directing the Clinical Inquiry as THE LANCET Commissioner, and the Report which he drew up appeared in the pages of THE LANCET in 1893. We take this opportunity of expressing our thanks to Dr. Dudley Buxton for his cordial co-operation. The work was one which involved the expenditure of much time and labour; we are therefore anxious to record our appreciation of the ungrudging way in which Dr. Dudley Buxton's services were rendered both on the occasion of the production of the Report and in the preparation of this volume for the press.

In reproducing the Reports some slight changes have been made in the text of the introduction and elsewhere necessitated by the character of the original Report, which, as it appeared serially in the columns of THE LANCET, needed textual reconstruction to render it consecutive; and a full description of the Manometer Experiments has (by the kind permission of the Nizam and the Government of Hyderabad) been added.

THOMAS WAKLEY.

THOMAS WAKLEY, JUNR.

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THE LANCET

AND THE

HYDERABAD COMMISSIONS ON CHLOROFORM

INTRODUCTORY.

THE Second Hyderabad Report on Chloroform gives a careful account of 588 experiments made on the lower animals. It undertook to investigate the way in which chloroform kills, and whether the condition of the animal at the time of the administration can be a determining cause of a peculiar form of fatality. Thus experiments were undertaken with dogs caught in the bazaars, with those prepared for experiment by fasting, and with those fed just before the chloroform was given. Some dogs were fed with phosphorus to produce fatty changes. Thus it was attempted to test the effect upon (1) fasting animals; (2) animals with full stomachs; (3) animals with heart disease; (4) animals diseased in other ways; (5) animals stimulated by alcohol, coffee, &c.; (6) animals who had various alkaloidal substances injected before the chloroform was given; (7) animals chloroformed in various postures—the vertical, the recumbent; and (8) animals chloroformed in various ways—with inhalers and without.

It may be well to give the results arrived at, and to do so as far as possible in the words of the Report:—

“The results in one respect are uniform. In every case where chloroform was pushed the respiration stopped before the heart.”

The interval elapsing between complete cessation of respiration and circulation differed according to envioning circumstances—it was shortest when the chloroform administration was complicated by circumstances giving rise to some asphyxia. The same is true of very slow and very prolonged administration.

Tracings are given at p. 58 of a large number of kymographic records, which were reproduced by photography, and which led the Commission to the following conclusions.

Chloroform given continuously, but properly diluted with air, and when no asphyxial or other complications exist, produces a gradual fall of mean blood pressure. This commences before unconsciousness supervenes; continues as the animal becomes insensible; then the respiration gradually ceases; and, lastly, the heart stops beating. If the dilution is less the fall of blood pressure is more rapid, “and however concentrated the chloroform may be, it never causes sudden death from stoppage of the heart.” The fall of blood pressure continues for a time after the chloroform has ceased to be inhaled. Holding of the breath produced fall of blood pressure and slowing of the heart beat. Struggling, when associated with holding of the breath, followed by gasping respiration or by quickened respiration, led to rapid fall of blood pressure. Slight continuous asphyxia gave rise to exaggerated and irregular oscillations of the blood pressure and slowing and irregularity of the heart's action.

In all these cases gasping respiration, being liable to succeed

the incomplete respiration, tends to produce an increased chloroform intake and to lessen blood pressure, and the animal takes an overdose. The Report also gives some valuable experiments taken to define the effect of vagal stimulation upon the chloroformed heart.

The Report makes the following important statement:—“Complete stoppage of the respiration always means that an overdose has been administered, and the overdose may be so great as to render restoration impossible. It is impossible to say whether, after chloroform has been pushed and then discontinued, the respiration will be restored spontaneously or not, and it is never in any case certain that artificial respiration will restore the natural respiration and blood pressure, no matter how soon it is commenced after the respiration stops. A great deal depends upon the after-fall [of the blood pressure]; in some cases even after the respiration has been restored the [blood] pressure continues to fall and respiration again ceases, and artificial respiration then fails. We thus find respiration restored by artificial respiration while chloroform is still being absorbed, and this tends to show that artificial respiration does not merely pump the chloroform out of the blood, but exerts considerable influence in exciting the natural respiration.” When concentrated chloroform vapour is pushed regardless of the breathing the heart stops, and its cessation is regarded by the Report as due “to stimulation of the vagus due to asphyxia.” The animal is easily restored, “as he is suffering more from asphyxia than chloroform poisoning.” It corresponds to those cases in which dangerous failure of the heart is said to have occurred some minutes after the administration of the chloroform had been discontinued, and which are sometimes restored, and sometimes not, by artificial respiration.

The effect of shock in incomplete anæsthesia upon the lower animals “in no case in any stage of anæsthesia produced anything even suggestive of syncope or failure of the heart's action.” Further direct irritation of the vagus proved that inhibition of the heart's action lessened rather than assisted the fatal effects of prolonged chloroform administration.” The experiments with shock, painful procedures being undertaken, showed no tendency in lower animals to produce cardiac failure. Animals suffering from fatty heart produced artificially showed no tendency to die from heart failure. After severe hemorrhage no tendency to cardiac failure revealed itself. Posture in the lower animals produced no tendency to syncope. Inversion, although raising the blood pressure, failed to produce recovery from chloroform overdose. This appears to be true of the cases in which the chloroform overdose produced failure of respiration, while the circulation was feebly maintained and failed after cessation of the breathing.

REPORT

OF

THE SECOND HYDERABAD CHLOROFORM COMMISSION.*

PART I.

THE ORIGIN OF THE COMMISSION.

[Two Commissions to examine into the alleged dangers of chloroform have been appointed by his Highness the Nizam's Government. The first (see Appendix) Commission, appointed in 1888, consisted of Surgeon Hehir, I.M.D., President, and of Messrs. J. A. Kelly, L.R.C.P. and S. Ed., and A. Chamarette, L.M.S. This Commission was applied for by Surgeon-Lieutenant-Colonel Lawrie, M.B., resident surgeon at Hyderabad, to investigate by experiments on dogs whether in death from chloroform the respiration always stops before the heart. To extend this line of research still further the second Commission was applied for and, through the extraordinary generosity of his Highness the Nizam, was granted. To his Excellency the Prime Minister, Sir Asman Jah, grateful thanks were tendered by the Commission for the unprecedented liberality and public spirit displayed by his Highness's Government in prosecuting these important researches. Personal support and encouragement were given during the carrying out of the Commission's work by his Highness the Nizam, the Nawab Munir-ul-Mulk, son of the late Sir Salar Jung, the Maharajah of Peshkar, and the Nawab Fakhr-ul-Mulk. Among the members of his Highness's Government who showed especial interest in the work are the Nawabs Mohsin-ul-Mulk, Vikah-ul-Mulk, Imad-ul-Mulk, his Highness's private secretary Intesar Jung, Fattah Nawaz Jung, and Mr. Fardonji Jamshedji, private secretary to Sir Asman Jah.

The lines on which the First Commission proceeded will be seen by reference to p. 78, on which the report is printed. They may be briefly stated here:—

EFFECTS OF CHLOROFORM ON CIRCULATION AND RESPIRATION.

The doses and methods of administration were varied as much as possible and different percentages of air given. The report was in due course presented and embodied in the annual report of his Highness's Medical Department for 1888. The experiments of the Commission led them to conclude that chloroform may be given to dogs by inhalation with perfect safety and without any fear of accidental death, if only the respiration, and nothing but the respiration, be carefully attended to throughout. This conclusion was, however, not accepted by the medical press in England and America. The profession in Great Britain were largely influenced by experimental results obtained by various observers who were not wholly in accord with the views promulgated by the first Hyderabad Commission. The teaching of the reports of the Royal Medical and Chirurgical Society and the Glasgow Chloroform Commission of the British Medical Association was also not in harmony with this conclusion, and so it was determined to extend the Hyderabad experiments. Through the exertions of Surgeon-Lieutenant-Colonel Lawrie and the munificence of his Highness the Nizam of Hyderabad this was accomplished.

A second Commission was initiated, of which the following is the report, and Dr. Lauder Brunton became THE LANCET's representative and assessor to the Commission, his Highness the Nizam providing £1000 for this purpose and defraying the expenses of the Commission's work. Thus many of the grave difficulties which surrounded such an undertaking were removed.]

But there is still another difficulty: however fair and impartial the Hyderabad Commission may try to be—and even though those who differ from them may credit them with care, honesty, and impartiality—its conclusions will always be open to the objection that the Commission may be mistaken, and any mistake on its part would be all the more fatal and disastrous, because its conclusions would be very difficult to disprove, since they are founded on such a mass of experimental evidence as has never been collected before, and is hardly likely to be collected again—at least, for many years. To avoid such a possibility the Commission have tried, as far as possible, to give the experimental data from which their conclusions are derived, so that at any future time and in any part of the world these data will be as available to others as to themselves, and may be used by them either for the purpose of criticising the Commission's conclusions or drawing conclusions of their own. The utility of such a course has been impressed upon the Commission during the progress of this investigation by the example of the Glasgow Committee, which they have followed. The Glasgow Committee drew from one experiment alone the sweeping conclusion that chloroform has sometimes an unexpected and capricious effect on the heart's action, and that “the occurrence of these sudden and unlooked-for effects seems to be a source of serious danger.” This conclusion is obviously of the utmost importance in regard to chloroform. The leading therapist in the United States writes, “As an anæsthetic, chloroform possesses the advantages of quickness and pleasantness of operation, smallness of dose, and cheapness. These advantages are, however, so outbalanced by the dangers which attend its use that its employment under ordinary circumstances is unjustifiable.”¹ If the Glasgow Committee had only given their conclusions, it would have been very difficult indeed to disprove them; but fortunately they have published a copy of the manometer tracing on which these conclusions are founded, and an inspection of this leads inevitably to the belief that the sudden and unlooked-for effects on the heart's action which the Committee attributed to chloroform are not really due to it at all, but are due to irritation of the vagi quite apart from the action of the anæsthetic, and are the result of accidental asphyxia. The Commission have followed the excellent example of the Glasgow Committee, and reproduced by photography the tracings on which their opinion is based, so that all those who look at them and compare them with the tracings of the Glasgow Committee, which they have also reproduced, may judge for themselves, and form their own opinions on the subject. (See p. 73.)

Dr. Lauder Brunton and Surgeon-Major Bomford arrived in Hyderabad on Oct. 21st, 1889, and the second Commission was constituted at once as follows:—Surgeon-Major E. Lawrie, M.B. Edin., President; Dr. T. Lauder Brunton, F.R.S., Dr. Rustomji, H.H. the Nizam's Medical Service (members), Dr. Bomford, secretary.

Associated with the second Commission were the President and members of the first Commission—viz.: Surgeon P. Hehir, M.D., President; Mr. J. A. Kelly, L.R.C.P. and S. Ed., L.F.P. and S. Glasg., and Mr. A. Chamarette, L.M.S., Members. The Commission is very much indebted to all the gentlemen mentioned, as well as to Mr. William Mayberry, who gave chloroform; but is

¹ H. C. Wood's “Therapeutics.”

* The Report of the First Hyderabad Chloroform Commission appears at p. 78.

especially so to Dr. Arthur Chamarette, to whose energy and fertility of resource the success of the experiments is mainly due. The Commission also desires to thank Mr. Tripp, the Deputy Principal of the Medical School, and Mr. Carroll, his Highness the Nizam's Medical Storekeeper, for much valuable assistance ungrudgingly afforded.

The Commission commenced work on the 23rd October, and met daily, except on Sundays and holidays, from 7 A.M. till 5 P.M., until the 18th of December, when the experiments were concluded.

The Commission was divided into two Committees: one, which will be referred to throughout the report as the Committee, was composed of Drs. Lauder Brunton, Bomford, Hehir, and Chamarette; the other, which will be referred to as the Subcommittee, was composed of Dr. Rustonji, Mr. Kelly, and Dr. Gay (who volunteered to help), assisted by students.

The Committee first of all performed twenty-seven experiments (p. 12), numbered from 1 to 28, omitting 25, which was a manometer experiment, to test the work of the first Commission. From No. 29 (p. 36) the Committee were employed principally with blood-pressure experiments. The ordinary experiments, performed without recording apparatus, were then made over to the Subcommittee (p. 15), which continued to work in the same room under the supervision of the Commission.

The experiments of the Subcommittee are numbered continuously with those of the Committee, so as to form a consecutive series and facilitate reference.

PART II.

GENERAL EXPERIMENTS WITHOUT RECORDING APPARATUS.

The experiments of the Subcommittee, together with the first twenty-eight performed by the Committee, form a total of 430, and are divided into seven sections. These experiments are recorded in a tabular form at p. 12, *et seq.*, 268 dogs and 31 monkeys were killed outright, and 86 dogs and 39 monkeys were subjected to artificial respiration at varying intervals after the natural respiration had been arrested with chloroform. The animals which were killed had chloroform administered to them in every possible way and under every conceivable condition. A large number of dogs were killed just as they were caught in the bazaars; others at various intervals after having heavy meals of meat or farinaceous food or fat; others fasting; others after the administration of Liebig's extract of meat, coffee, rectified spirits of wine, or ammonia. Most of these animals were healthy, but some of them had cardiac disease, and in many the heart and other organs were rendered fatty by the previous administration of phosphorus. In a large number of cases morphine, strychnine, and atropine, singly and in combination, were given by subcutaneous injection at intervals before the inhalation was begun. Chloroform was given with and without inhalers; in the vertical and recumbent positions; in glass and wooden boxes; in large and small doses; by being pumped into the trachea with bellows; and, in fact, in every way that could suggest itself to the Commission.

The results in one respect are uniform. In every case where chloroform was pushed the respiration stopped before the heart. The table on the next page shows the interval of time between the cessation of respiration and of the heart's action in dogs and monkeys in uncomplicated cases, and in cases complicated by asphyxia and by the administration of certain drugs subcutaneously before the chloroform inhalation was commenced.

The movement of the heart was in the first 66 cases of the Subcommittee tested by auscultation, but afterwards by a needle inserted through the chest wall into the organ, and the thoracic cavity was laid open when doubt existed.

In the majority of the uncomplicated cases, which include those fed in different ways before inhalation, the heart ceased to act in from two to six minutes after stoppage of the respiration. In one uncomplicated case the heart's action ceased within one minute after the breathing stopped. The heart ceased within one minute after the respiration stopped in two cases where the inhalation was very slow and prolonged, in four cases complicated by asphyxia, and in one where the subcutaneous injection of

morphine (gr. $\frac{1}{2}$) and strychnine (gr. $\frac{1}{1000}$) was administered beforehand. The maximum time the heart continued to beat after the respiration ceased, in the experiments of the Subcommittee, was eleven minutes in a dog and twelve in a monkey.

The effects of chloroform do not appear to be interfered with or much influenced by any of the variations in the method of preparation of the animal for, or of the administration of, the anæsthetic. There are four general exceptions to this statement. In very slow and prolonged administration, and in cases complicated with partial asphyxia, as well as in one case where one-third of a grain of atropine was administered before the inhalation, the heart stopped very soon after the respiration ceased; and in all cases where the inhalation was accompanied by struggling the animals became insensible with unusual rapidity. In these cases also the interval between the cessation of respiration and the time of possible restoration by artificial respiration was shortened. (*Vide* pages 12 to 35.)

As regards the restorative effects of artificial respiration the Subcommittee found it was nearly always successful if commenced within thirty seconds after the respiration ceased, very seldom successful if commenced between thirty and sixty seconds after, and always unsuccessful if not begun till after sixty seconds. In forty-four cases in which artificial respiration proved successful it was commenced on an average 28.2 seconds after natural respiration ceased. In thirty-eight unsuccessful cases the average was 31.5 seconds.

The Subcommittee formed the opinion that artificial respiration was less successful in restoring the respiration after it had been stopped by chloroform in cases where a subcutaneous injection of morphia was administered before the inhalation was commenced. There were eighteen cases in which this was tried. In the first six artificial respiration was commenced eight seconds after cessation of natural respiration; of these five died. In three cases artificial respiration was begun fifteen seconds after the natural respiration ceased, and of these two recovered and one died. In three cases in which artificial respiration was commenced twenty seconds after the respiration stopped, two out of the three died; and, lastly, in six cases where artificial respiration was not commenced till thirty seconds afterwards five died and one was revived. The average of those cases that were revived was 17.6 seconds, and of those that died in this series 26.4 seconds. This opinion was tested by blood-pressure experiments Nos. 162 and 178, the results of which did not support their conclusion.

EXPERIMENTS WITH RECORDING APPARATUS.

The experiments carried out by the Committee with self-recording apparatus consist of Nos. 25 and 29 to No. 185 inclusive. In a certain number of cases the animal died accidentally before it was ready to be attached to the manometer, and in others for various reasons the experiment was not completed; but for the sake of convenience they have all been left in the order in which they occurred, and are described *seriatim* in the explanatory notes. A full description of the kymographs, with the aid of which the blood-pressure experiments were carried on, is given on p. 9, and all these experiments are illustrated by photographs of the kymographic records. A few of these plates illustrate experiments in which the movements of the heart only were recorded by a simple apparatus, which is also described. In every case in which a tracing was obtained it has been without exception preserved, and is reproduced in this report by photography. In this way the whole of the work of the Committee recorded by the manometer has been rendered available for study at any time by anyone who is interested in the subject. The photographs are on a reduced scale; but with the aid of a 2 or 3-inch lens, and perusal of the explanatory notes on the page opposite to them, the reader will have no difficulty in deciphering and understanding the remarks recorded on the tracings. The explanatory notes, which were written partly at the time of, and partly immediately after, each experiment, were made from the remarks which were recorded on the manometer during the course of the experiments. It is impossible to arrange the manometer experiments so as to group together those which appear to illustrate particular points, because almost every experiment includes a variety of procedures which suggested themselves at the time as likely to elucidate something in

respiration is not impeded in any way, and it continues to breathe quietly without struggling or involuntary holding of the breath—as almost always happens when the chloroform is sufficiently diluted. As this fall continues, the animal first becomes insensible, then the respiration gradually ceases, and lastly, the heart stops beating. If the chloroform is less diluted the fall is more rapid, but is always gradual, so long as the other conditions are maintained; and however concentrated the chloroform may be, it never causes sudden death from stoppage of the heart. The greater the degree of dilution the less rapid is the fall, until a degree of dilution is reached which no longer appreciably lowers the blood pressure or produces anaesthesia.

If the inhalation is interrupted at any stage, the fall of pressure still continues at a rate which depends altogether on the rapidity of the fall while the chloroform was being inhaled. This after-fall is probably due to absorption of a portion of the residue of chloroform in the air passages after the stoppage of the inhalation. In this way it often happens, if chloroform is given rather freely, that, though the respiration may be going on when the chloroform is discontinued, it afterwards stops.

If the administration of the chloroform is stopped at an early stage, the pressure very soon begins to rise again, and gradually becomes normal; but if the chloroform is pushed further, there comes a time, not easy to define, when the blood pressure and respiration will no longer be restored spontaneously, although the heart continues to beat after the inhalation is stopped.

If the fall has been very gradual, it may occasionally happen that the respiration stops completely, and still the blood pressure rises again, the respiration recommencing spontaneously in the course of the rise. In the same way, when the inhalation has been discontinued, the respiration may stop during the after-fall of the blood pressure and begin again spontaneously. As a rule, if the respiration has stopped, or even becomes slow and feeble at the time when the inhalation is discontinued, and artificial respiration is not resorted to, the fall in blood pressure will continue until death ensues.

There are two conditions which frequently disturb the gradual fall of the blood pressure—viz., struggling and holding the breath,—and it is only by great care that they can be avoided in animals.

Struggling, independently of any change in the respiratory rhythm, appears generally to raise the blood pressure.³ In one case of a dog much weakened from phosphorus⁴ the pressure fell every time he struggled.

When struggling is accompanied, as it often is, by acceleration of the respiration and pulse, especially if the respiration is deep and gasping, it leads to a more rapid inhalation of chloroform, and consequently to a more rapid fall of blood pressure and a greater after-fall. In order to keep the chloroform cap or inhaler in its place during the animal's struggles, the administrator is obliged to hold it down more tightly over the nose and mouth, and this materially assists in hastening the rapidity of the inhalation, and consequently of the fall in blood pressure.

The effect of involuntarily holding the breath—which, as anybody can prove by experiment upon himself, must happen when an inhaler saturated with chloroform is first applied to the face—is much more remarkable, the pressure often falling with great suddenness, while the heart's action is markedly slowed.⁵ As soon as the animal draws breath again, the pressure rises as suddenly as it fell, but the gasping respiration which succeeds then causes very rapid inhalation of chloroform, with immediate insensibility and a rapid fall of blood pressure, which quickly becomes dangerous.

The combination of struggling with alternate holding the breath and gasping, which results if chloroform is applied closely to the face without sufficient dilution with air, causes violent fluctuations, and then a speedy fall of the blood pressure, which very soon leads to a dangerous depression with deep insensibility and early stoppage of the respiration. The after-fall under these circumstances is rapid and prolonged. It is this combination of events which causes struggling animals to go under chloroform so quickly.

The effect of holding the breath may occasionally cause a temporary fall of blood pressure after the chloroform inhalation has been stopped,⁶ or even when the animal is quite out of chloroform.⁷ This fall is recovered from directly the animal breathes again.

Slight continuous asphyxia, such as is produced by pressure on the neck by straps, a badly-fitting muzzle, or hindrance of the chest movements by the legs being too tightly bound down, gives rise to exaggerated and irregular oscillations of the blood pressure, and slowing and irregularity of the heart's action. If it leads to, or is accompanied by deep gasping inspiration, it is apt, like anything else which causes this, to increase the intake of chloroform and bring about a rapid decline of blood pressure.

Complete or almost complete asphyxia, as by forcibly closing the nose and mouth⁸ or closing the tracheal tube after tracheotomy,⁹ has an effect similar to, but more marked than, that produced by holding the breath, and the character of the trace corresponds precisely to that produced by irritation of the peripheral end of the cut vagus. The pressure falls extremely rapidly, sometimes almost to zero, and the heart's action becomes excessively slow, or even stops for a few seconds. If the Fick trace of Experiment 148 be compared with the photographic reproduction of Trace A of the Glasgow Committee, it will be seen that they are identical, and that the slow action of the heart with great fall of pressure, which the Glasgow Committee attributed to some capricious action of chloroform upon the heart, was undoubtedly due to asphyxia.

This effect of asphyxia is the result of stimulation of the vagi. The proof of this is (a) that the trace corresponds exactly, as stated above, to that produced by direct irritation of the vagus, (b) division of both vagi entirely abolishes it,¹⁰ and (c) the administration of atropine which paralyzes the vagus also abolishes it.¹¹

In Trace 158 (Fick 4), which was taken during asphyxia after a full dose of atropine, it will be seen that there is an alternately slow and rapid pulse according to the phase of the respiratory movement, but no continued slowing of the heart as in vagus irritation. But there was still a distinct fall of pressure after the atropine when the breath was held, and it was thought that the slowing of the pulse above noted in this condition might be due to the disturbance of the heart from tension in the pulmonary vessels in the absence of respiratory movement, rather than to irritation of the vagi. To test this point Experiment 184 was instituted. In this experiment the dog's chest was forcibly inflated with bellows connected by a tube with the trachea, and the effect of this proceeding was to cause a fall of pressure and the slowing of the heart exactly the same as involuntary holding of the breath. The dog was then poisoned with atropine, after which inflation of the chest still caused a fall of pressure, but without slowing of the heart.¹² The fall of pressure must be in some degree independent of vagus irritation, which, however, usually accompanies it.

It only remains to be considered whether the slow action or temporary stoppage of the heart with great fall of pressure produced by vagus irritation is in itself an element of danger in chloroform administration, and if it is not, wherein the danger actually lies.

The experiments in which deliberate irritation of the vagi was carried on during anaesthesia show unmistakably that irritation of these nerves diminishes rather than enhances the danger of anaesthetics. The effect upon the heart is never continuous, and as the vagus becomes exhausted, or when the irritation is taken off, the blood pressure rises again, as it does when the same result is produced by asphyxia. The slowing of the heart and circulation which is produced by irritation of the vagus by any cause, such as holding the breath in chloroform administration, retards the absorption and conveyance of chloroform to the nerve centres, just as holding the breath, whether voluntary or involuntary, prevents chloroform from entering the lungs; and of itself slowing or temporary stoppage of the heart in chloroform administration is not dangerous.

To answer the second part of the last question is easy enough, if it is kept in mind that the effect of vagus irritation upon the heart is never continuous;

³ Vide Experiment 82.

⁴ Vide Experiment 161. See also Experiment 183.

⁵ Vide Experiments 103, 119 Fick 2, 157 Fick 4, and many others. See index under Breathholding.

⁶ Vide Experiment 157.

⁷ Vide Experiment 185.

⁸ Vide Experiments 148, 150, 151.

⁹ Vide Experiment 66.

¹⁰ Vide Experiment 150.

¹¹ Vide Experiment 168, Fick 4.

¹² Vide Fick, Experiments 8 and 9.

and in chloroform administration, as the pressure rises again after the slowing of the heart and temporary fall of pressure produced by any form of asphyxia, violent respiratory efforts with bounding heart's action lead, as in the case of struggling, to a rapid and dangerous inhalation of chloroform, and consequent rapid and dangerous decline in blood pressure. It is, in fact, the temporary exhaustion of the vagi after stimulation that is to be feared, and not the actual stimulation as long as it is continued.

In accordance with this fact, it will be found that in chloroform administration neither holding the breath, even if involuntary, or vagus inhibition can be kept up beyond a certain time; and if the chloroform is not removed from the face, one or both of two things may happen: (*a*) when the animal breathes again, it takes deep and gasping inspirations, the lungs become filled with chloroform, and an over-dose is taken in with extreme rapidity; or (*b*) when the restraining influence of the vagus is taken off the heart, through the irritation ceasing or the nerve becoming exhausted, the heart bounds on again, and the circulation is accelerated in proportion. The blood then becomes quickly saturated with chloroform, and an over-dose is at once conveyed to the nerve centres. The theory which has hitherto been accepted is that the danger in chloroform administration consists in the slowing or stoppage of the heart by vagus inhibition. This is now shown to be absolutely incorrect. There is no doubt whatever that the controlling influence of the vagus on the heart is a safeguard, and that it is the exhaustion of the nerve which is dangerous.

It can be readily understood how a condition in which the pulse is rapid and bounding, with high blood pressure, leads to more rapid absorption of chloroform from the lungs, and a more rapid propulsion of the chloroformed blood to the medulla oblongata, and consequently to a more rapid paralysis of the respiratory and vaso-motor centres and precipitous fall in the blood pressure. Such a condition is produced in some cases by ether or by division of both vagi¹³ or by a full dose of atropine.¹⁴ Not only is the poisoned blood carried more swiftly to the vital centres in these cases, but added to this there is the fact that, as the heart is already doing its utmost before the chloroform is given, it is unable to stave off by increased work the fall in pressure that occurs when the vaso-motor centre is paralysed. On the other hand, it seems clear from Experiment 92 that the direct action of chloroform upon the heart's substance is not the cause of the fall of pressure that occurs when it is inhaled.

In Experiment 92 repeated injections of 20 minims of chloroform were made into the jugular vein, and its effect was not to paralyse the heart, but to produce anaesthesia and a gradual fall of blood pressure exactly as if the chloroform had been inhaled. In Experiment 72, after a considerable amount of ether had been injected into the jugular vein, and a bounding condition of pulse had been produced, the effect of injecting chloroform into the jugulars was much greater, and the fall of blood pressure much more rapid and dangerous, than in the case when chloroform was alone injected. Granting, then, the truth of Ringer's conclusions from experiments on the frog's heart (which have not been repeated and confirmed by the Commission) that chloroform has a gradual paralysing effect upon the heart's tissue, we must conclude that such an effect, in the degree in which alone it could occur in the practical inhalation of chloroform, would rather be a source of safety than of danger.

The Committee discussed the advisability of cutting the vagi some time previously to experimenting on the blood pressure with chloroform. The effect of this procedure is to cause continuous rapid action and tendency to exhaustion of the heart, as well as to degeneration of the terminal branches of the nerves in the heart if the animal live sufficiently long. Such experiments might be of some interest theoretically, and also have had a practical bearing upon the condition of the heart in certain cases of chronic alcoholism; but the Committee decided not to perform them, as it considered the end to be gained did not justify the pain they would have inflicted.

In Experiment 178, the case of a dog that had had morphine, remarkable slowing and even temporary cessation of the heart's action occurred again and again at the

same moment as the respiration stopped,¹⁵ but the heart invariably recovered itself, and began again to beat regularly before any steps were taken to restore the animal, and without any respiration occurring. We find in this case that it was possible to restore the animal even after unusually long intervals had been allowed to elapse between the cessation of the natural and the commencement of artificial respiration. The failure of the heart, if such it can be called, instead of being a danger to the animal, proved to be a positive safeguard, by preventing the absorption of the residual chloroform and its distribution through the system.

The effect of artificial respiration after the natural respiration has ceased is to cause an alternate rise and fall of small amount in the blood pressure, the trace thus formed upon the drum being a coarse imitation, altered somewhat by the shaking of the table, of the natural respiratory curve. The difference consists chiefly in the fact that the artificial rise and fall are more abrupt than in natural breathing, and that the rise always coincides with expiration or compression of the chest. After artificial respiration has been continued for a certain time, the blood pressure begins to rise again, and a little later natural respiration returns.

The effect of artificial respiration in restoring an animal after the respiration had stopped was always marked. In a few exceptional cases, such as Experiment 159, a phosphorus dog, and Experiment 142, a horse which had an enormous over-dose, although the artificial respiration was commenced as soon as possible after the breathing was noticed to have stopped, it was not successful.

Complete stoppage of the respiration always means that an over-dose has been administered, and the over-dose may have been so great as to produce a very prolonged after-fall of blood pressure, and may thus render restoration impossible. As it is impossible to say whether, after chloroform has been pushed and then discontinued, the respiration will be restored spontaneously or not, so it is never in any case certain that artificial respiration will restore the natural respiration and blood pressure, no matter how soon it is commenced after the respiration stops. A great deal depends upon the amount of the after-fall; in some cases, even after the respiration has been restored, the pressure continues to fall and respiration again ceases, and artificial respiration then fails. We thus find respiration restored by artificial respiration while chloroform is still being absorbed, and this tends to show that artificial respiration does not merely pump the chloroform out of the blood, but exerts considerable influence in exciting the natural respiration.

The time which elapses before artificial respiration succeeds in restoring natural respiration varies very greatly. In one case (Experiment 116) it was continued for eleven minutes before the first natural gasps commenced. This period is undoubtedly prolonged in some cases by a condition of physiological apnoea, which renders it unnecessary for the animal to breathe. Consequently, whenever the pressure rose considerably during artificial respiration it was stopped, and the animal then generally breathed after a few seconds.

The time which may be allowed to pass with impunity before commencing artificial respiration also seems to vary considerably. This point was not particularly attended to in the manometer experiments except in Experiments 162 and 178, which were instituted to test the truth of the opinion formed by the Subcommittee that morphine had some slight action in impairing the efficiency of artificial respiration. In these cases the commencement of artificial respiration was postponed for more than two minutes after respiration ceased, and was successful; but this is certainly far above the average interval that can be allowed with safety. The success of artificial respiration in restoring the blood pressure is in some cases very remarkable; *vide* especially Experiment 48, in which the heart had apparently ceased beating,¹⁶ and the dog was believed by everyone present to be dead, and yet recovered with artificial respiration. The success in this instance is due to the fact that chloroform had only been administered for a few seconds, and that the depression was the result, not of continuous chloroform administration until respiration ceased, but of a long and severe after-fall.

¹⁵ Vide Experiment 178, Fick Readings 2 and 3, 8, 13, 18, and 26; and compare Experiment 49, Fick Readings 2 and 8, and Experiment 60, Fick Reading 3, which are similar cases, but were not so carefully observed.

¹⁶ Vide Fick Reading, 12.

¹³ Vide Experiments 151 and 156. ¹⁴ Vide Experiment 80.

It corresponds to those cases, which are so often reported, in which dangerous failure of the heart is said to have occurred some minutes after the administration of chloroform had been discontinued, and which are sometimes restored, and sometimes not, by artificial respiration. There is nothing at all sudden about the failure of the heart in these cases, but the attention of the chloroformist, which has been wandering, is suddenly called to the fact that the patient is apparently dead. When the animal was really dead, it was found in some cases that artificial respiration still maintained a small amount of mean pressure in the manometer. In others the pressure seemed to fall to the zero line between each compression of the chest.

The dangers of too vigorous artificial respiration were illustrated in some of the accidental deaths. In one case the liver was badly ruptured, and in another the pleural cavity was full of blood. In three cases—Experiments 80, 92, and 103—rhythmic movements of the diaphragm were noticed after the heart had ceased beating and after the chest had been opened. It is remarkable that in two of these cases the splanchnic nerve had been divided. The third was a case in which chloroform had been injected into the jugular vein, and in this case there was a synchronous movement of the jaw as well. In all, death and stoppage of the heart had occurred gradually, and in Experiment 103 the heart was still irritable. These movements cannot be called respiration; though the last gasp of a dying animal, that ineffective jerk of the diaphragm, which is such a fatal symptom, is very likely in many cases a movement of the same character. Similar movements, which were continued much longer, occurred in Experiment 104, after the thorax was opened, while the heart was still beating. Still more remarkable convulsions of the muscles of the jaws, ears, and fore-feet occurred in Experiment 167, in the case of a dog that had been poisoned with nicotine. These movements continued at regular intervals for more than ten minutes after death, and were sufficiently forcible to jerk the handles of a pressure forceps fixed on the end of the tongue off the table at each spasm. In a rabbit, in Experiment 153, the auricles of the heart continued to beat rhythmically for three hours after it was supposed to be dead from chloroform and its thorax had been laid open. Irritability of the heart after death was noticed in many cases, but seemed to be most marked in cases where ether had been used.

Chloroform injected into the heart through the jugular vein did not cause clotting of the blood, as was the case when ether was injected.

In the course of the experiments of the Committee various drugs were administered in order to ascertain if they had any effect in modifying the action of chloroform. The result showed that none of them had any effect in preventing the typical descent of the blood pressure that occurs when chloroform is inhaled. Atropine, when given in a dose sufficient to paralyse the vagi, of course prevents the action of those nerves in asphyxia, and by increasing the action of the heart it appears to cause a more rapid descent in the blood pressure when chloroform is inhaled, as has been already explained. Morphine appeared in Experiment 162 to render the rise in blood pressure that occurred when the chloroform was discontinued slower and less complete, and to bring about a more or less permanent condition of anaesthesia. It may be noted that the animal used in this experiment was a monkey; and in other experiments with monkeys, when no morphine had been given, it was remarked that the animal, after a few inhalations of chloroform, would often lie quite quiet in a state of semi-insensibility for a long time without further inhalations; still, this condition was much more marked in Experiment 162 than in any of the others. No action of this kind was noticed in the dog in Experiment 178, but other experiments (90 and 94) showed that pariah dogs are very indifferent to the action of morphine, and it is probable that the dose of morphine in this case was insufficient to bring about the condition noted in the monkey. The peculiar behaviour of the heart in Experiment 178 was not the result of the previous administration of morphine, for a similar phenomenon had occurred in other cases (49 and 60) in which no morphine had been given. Experiments 162 and 178 prove conclusively that morphine has no effect in shortening the period that may be allowed to elapse between the cessation of natural respiration and the commencement of artificial respiration.

The other drugs used had no effect upon the action

of chloroform except when their own special action became the leading feature in the case—as, for instance, during the vomiting from apomorphine (Experiment 104, Fick 9) or the convulsions produced by nicotine (Experiment 167).

In order to test the alleged danger from shock during chloroform administration, the Committee performed a very large number of those operations which are reputed to be particularly dangerous in this connexion—such as extractions of teeth, evulsion of nails, section of the muscles of the eye, snipping of the skin of the anus, &c. In many cases the operation was performed when the animal was merely stupefied by the chloroform and not fully insensible. In such cases a slight variation in the blood-pressure would sometimes occur, such as one would expect from the irritation of a sensory nerve or from the struggling that ensued, but in no case in any stage of anaesthesia was there anything even suggestive of syncope or failure of the heart's action. In thrusting a needle into the heart there was often a momentary but well-marked fall of blood-pressure; but even this was absent in all other injuries. If chloroform really had any power to increase the tendency to shock in operations, it is impossible to believe that it would not have been manifested, to some degree at least, in one or other of these numerous experiments. The Commission was, however, not content with this negative result, and determined to ascertain the effect of direct irritation of the vagi during continued chloroform administration. The result of such experiments (65, 117, and others) proved that inhibition of the heart's action prevented, rather than assisted, the fatal effects of prolonged chloroform inhalation. An animal that was put into a condition of extreme danger (from which it could only be restored by means of artificial respiration) by inhalation of chloroform for one minute recovered spontaneously and readily after five minutes of chloroform inhalation, together with inhibition of the heart by electrical irritation of the vagus carried on simultaneously. In one of these experiments (117), chloroform was pushed for seven minutes; and during continued irritation of the vagus the animals repeatedly came round without artificial respiration. The danger really begins when the irritation is discontinued or fails to inhibit the heart, and thus enables the chloroform in the lungs to be rapidly absorbed and thrown into the system. The danger is certainly increased by deliberately pumping the chloroform into the lungs by means of artificial respiration, for animals in which this was done, although they showed a tendency to recover when the chloroform and irritation of the vagus were discontinued, afterwards died rapidly.

On another occasion, during Experiment 117, the animal was very nearly killed by a comparatively short inhalation of chloroform, owing to the electrodes becoming accidentally short-circuited and failing to keep up the irritation of the vagus. Something similar occurred in Experiment 117, the effect of the irritation of the vagus passing off while the chloroform was still being pushed, and thus putting the animal into a condition of extreme and unexpected jeopardy. Nothing could be more striking than these near approaches to accidental death from failure to irritate the vagus efficiently.

Other experiments were made to test the truth of the statement that chloroform increases the action of electrical stimuli applied to the vagus, and showed conclusively that it has no such effect. In one instance only¹⁷ the inhibition seemed to be intensified as the chloroform was commenced, and diminished when it was discontinued; but apart from the fact that the supposed effect ceased much too suddenly, a repetition of the experiment on the same and other animals showed that there was in reality no such effect. The increased inhibition in this instance was due to the chloroformist compelling the attendant who was holding the electrodes to change his position, and thus making him unconsciously apply them more efficiently. When the chloroformist withdrew they were restored to their former position. This affords an instance of the care that has to be taken in making experiments if one is not to be deceived.

To test the effect of shock due to vaso-motor change rather than affection of the heart, Goltz's experiment on the frog was repeated on three dogs. In one there was slight lowering of pressure, which was not extensive, and in the others no effect was produced at all. Other operations which seemed likely to produce shock, such as violent blows

¹⁷ Vide Experiment 117, Fick Reading 6.

upon the testicle, were singularly devoid of effect. Failing to lower the blood pressure by any of these methods, recourse was had to section of the splanchnics; but the low condition of blood pressure this produced appeared, like stoppage of the heart from vagus irritation, to be a source of safety rather than of danger during chloroform administration. In this connexion Experiment 111 may be studied. There was not much external hæmorrhage, but the splanchnics were divided—a proceeding which, as is often said, bleeds the animal into his own vessels. The pressure was after this extremely low, but chloroform was repeatedly given and various other actions taken, and then chloroform had to be pushed on a saturated sponge enclosed in a cap for eleven minutes before respiration ceased.

The conclusion, then, is this: Chloroform has no power of increasing the tendency to either shock or syncope during operations. If shock or syncope from any cause does occur, it prevents, rather than aggravates, the dangers of chloroform inhalation.

The experiments on dogs that had been dosed with phosphorus for a few days previously show that the fatty and consequently feeble condition of the heart and other organs so produced has no effect in modifying the action of chloroform. The case with which vagus irritation and the Glasgow trace could be produced in these animals, by even slight degrees of asphyxia,¹⁸ was very remarkable; but this was equally the case in dogs that had been given phosphorus only a few hours before the experiment, and whose organs were not yet fatty.¹⁹ Many of these cases were in the last stage of phosphorus poisoning, and several of their companions died without any experiment having been performed on them before or on the same day as they died (*vide* the low state of blood pressure in Experiment 163). Numerous attempts were made in these animals to produce shock by operations in the recumbent and vertical positions, but without any more result than in those that were healthy.

The truth about the fatty heart appears to be that chloroform *per se* in no way endangers such a heart, but, on the contrary, by lowering the blood pressure, lessens the work that the heart has to perform, which is a positive advantage. But the mere inhalation of chloroform is only a part of the process of the administration in practice. A patient with an extremely fatty heart may die from the mere exertion of getting upon the operating table, just as he may die in mounting the steps in front of his own hall door, or from fright at the mere idea of having chloroform or of undergoing an operation, or during his involuntary struggles. Such patients must inevitably die occasionally during chloroform administration, and would do so even were attar of roses or any other harmless vapour substituted for chloroform.

The effect of the hæmorrhage was tested by opening the femoral artery and allowing a considerable quantity of blood (eight to twelve ounces) to escape. An immediate lowering of the blood pressure results, and this is very slowly recovered from. Such an accident, however dangerous it may be in itself, in no way effects the action of chloroform, except in so far that a patient who has been nearly bled to death would require less chloroform in his system to put him into a state of anaesthesia. The low condition of his blood pressure produced by the hæmorrhage would tend to prevent the too rapid intake of chloroform, exactly as in the case of cutting the splanchnics.

When the hind feet are lowered on to the floor so as to place the animal in the vertical position, a considerable fall of blood pressure in the carotid artery occurs; but when the animal is replaced on the table in the recumbent position the pressure is fully restored. Various operations were performed on animals in the vertical position, but in no case was anything resembling dangerous shock produced. Inversion of the body, so that the animal stands on its head, has exactly the opposite effect, the pressure rising in the carotid artery, and again falling to its former state when the animal is replaced in the horizontal position. Inversion of the body failed to restore an animal that was in the last stage of chloroform poisoning,²⁰ though it raised the pressure in the usual way as long as it was continued. The change in the pressure of the blood of the carotid, which occurs when the position of the body is changed, appears therefore to be due simply to the effect of gravity.

As regards the effect of chloroform upon different animals, it may be said to be the same as far as its anæsthetic action is concerned. There are certain peculiarities in its effect on the respiration and circulation connected with its local irritant action on the nostrils and fauces which are interesting to notice. Thus, when concentrated chloroform vapour is applied to the nostrils of rabbits, they hold their breath, and the heart's action is slowed at once. This is always said to be due to reflex inhibition of the heart from irritation of the nasal branches of the trigeminus reflected through the vagus, and is by no means peculiar to chloroform, but is produced equally by any irritant vapour, such as ammonia or acetic acid.

In some dogs, and especially in those to which phosphorus had been given, stoppage of the respiration and slowing of the heart occurred immediately after the application of the chloroform to the face, or on forcibly pulling out the tongue,²¹ and this suggests that the mechanism of cardiac arrest in them is precisely the same as it is in the rabbit. On the other hand, in rabbits, as in all other animals, it is possible to give chloroform so gently that no spasm of the chest occurs, no reflex effect is produced, and then the pressure falls in the same regular curve and with the same succession of phenomena (anæsthesia, cessation of the respiration, and lastly cessation of the heart beat) that was above described as typical of chloroform inhalation.²²

Goats have a great tendency to hold their breath while inhaling chloroform, and monkeys resemble dogs rather than rabbits, as when ammonia was held before a monkey's nose (Experiment 98) it did not cause immediate stoppage of the respiration and heart as it does in rabbits.

The experiments with ether show that it is impossible to produce efficient anæsthesia with this agent unless some form of inhaler is used which thoroughly excludes the air. If an ordinary cap containing a sponge saturated with ether is applied very closely to the face, the animal generally holds its breath and struggles, and we at once get the fall of blood pressure and slowing of the heart that invariably occur under these circumstances.²³ If the ether is continued in this way after the animal has recommenced breathing, a condition of semi-anæsthesia results, in which the cornea is sometimes sensitive and sometimes insensitive, and the pressure rises and falls alternately to a slight amount and forms a wavy trace, which may be continued right round the drum²⁴ without any particular change. As soon as air is rigidly excluded, the pressure commences to fall gradually exactly in the same way as with chloroform, and with the same succession of phenomena—viz., first, anæsthesia, then cessation of the respiration, then of the heart movements, and finally death.²⁵ How far this is due to ether and how far to the results of asphyxia it is impossible to say, but an exactly similar succession of events can be brought about by making the animal inhale carbonic acid gas alone.²⁶

If surgeons choose to be content with a condition of semi-anæsthesia, it can no doubt be produced with perfect safety, though with discomfort to the patient, by ether held rather closely over the mouth. Such a condition of imperfect anæsthesia would never be accepted by any surgeon accustomed to operate under chloroform. If more perfect anæsthesia is required, it can be procured by excluding the air more rigidly, but then there is exactly the same danger as in giving chloroform. How very suddenly and rapidly the pressure may fall and death ensue is well shown by Experiment 33. Ether injected into the jugular vein produces a fall of blood-pressure and anæsthesia in the same way as chloroform does,²⁷ but in all cases in which it was so injected large clots were found in the heart immediately after death. It is interesting to note that Claude Bernard seems to have formed a very similar opinion with regard to ether, as the following quotations from his work entitled "*Leçons sur les Anesthésiques et sur l'Asphyxie*," published in 1875, show. The first quotation (p. 50) is as follows:—"Aussi, un certain nombre de chirurgiens proposèrent-ils d'abandonner le chloroforme pour revenir à l'éther, dont l'usage paraissait moins à craindre. Aujourd'hui encore, les chirurgiens de Lyons emploient préférablement l'éther. On croyait le chloroforme plus dangereux que l'éther parce qu'il était

²¹ Vide Experiment 185.

²² Vide end of Experiment 172.

²³ Vide Experiments 148 and 261.

²⁴ Vide Experiment 146.

²⁵ Vide Experiment 146.

²⁶ Vide Experiment 160.

²⁷ Vide Experiment 93.

¹⁸ Vide Experiment 143.

¹⁹ Vide Experiment 156.

²⁰ Vide Experiment 106.

plus actif; mais, en réalité, la fréquence relative des accidents par le chloroforme tenait peut-être tout simplement à ce que c'était cet agent anesthésique qu'on employait dans l'immense majorité des cas. Plusieurs discussions ont été provoquées par les partisans de l'éther, surtout par les représentants de l'école de Lyons, et il a été constaté que l'éther, lui aussi, avait produit un certain nombre d'accidents mortels. Les deux agents anesthésiques usités peuvent donc, l'un comme l'autre, entraîner quelques risques de mort, et la chirurgie humaine a conservé presque partout le chloroforme, dont l'action est plus rapide et plus complète." The second quotation, to be found on p. 101 of the same work, runs :—"Quant à l'éther et au chloroforme, leur action est à peu près la même au point de vue physiologique, sauf une différence d'intensité en faveur du chloroforme, ce qui nous fera généralement employer ce dernier corps de préférence à l'éther."

The A.C.E. mixture given gently with plenty of air and the other conditions mentioned before under chloroform produces the typical chloroform trace.²⁸ Given freely to a struggling animal, it can produce a very rapid and dangerous fall of blood pressure.²⁹ In Experiment 52, Pick 4 shows very perfectly the effect on the heart of holding the breath.

ACCIDENTAL DEATHS.

The notes of the cases of accidental deaths that occurred during our experiments have been left amongst the other notes in the position in which each occurrence took place, and they can be readily found by a reference to the index. The fatal result was brought about either by neglecting to watch the condition of the respiration during or after the administration of chloroform, especially while the carotid artery was being exposed, or from a reckless administration of chloroform in the endeavour to check or prevent struggles. In all the cases of accidental death the usual chloroformist was absent, and no one was attending to the chloroform. The notes would have been more complete if someone could have watched the condition of the animal and noted the gradual but unheeded cessation of respiration without calling attention to it. As it is, one has to be content with the remark that the breathing was noticed to have stopped at some particular time, but there is nothing to throw any light upon the condition during the important period that immediately preceded this discovery. A similar hiatus appears in the account of accidental deaths in the human subject, and is unavoidable. These cases are probably identical with the instances referred to by Snow, "in which animals died in a sudden and what was thought unaccountable manner whilst chloroform was given to prevent the pain and struggles which would be occasioned by physiological experiments."³⁰ The death was not really sudden, but only rapid, and the result of reckless administration of concentrated vapour in the first instance, and careless neglect of the condition of the respiration in the second. There is no evidence whatever that a single one of them was due to paralysis or sudden stoppage of the heart, as Snow assumes to have been the case.

It must be remembered, in studying the tracings, that, except when it is expressly stated to the contrary, chloroform was throughout administered very freely.³¹ The degree and rapidity of the fall of blood pressure are in almost all cases much greater than should be the case in administering chloroform to human beings. To avoid complicating the notes, the inhaler was kept on much more persistently, with none of those little interruptions while the cornea is being examined &c. which always occur in practice. The whole series, with few exceptions, may be characterised as examples of reckless administration of chloroform, and accidental deaths would have been much more numerous had it not been that, when once the animal was connected with the manometer, it was kept under the most careful observation. Experiment 79 affords a most interesting exception. The chloroformist, though present in body, was absent in mind, and failed to observe and report the cessation of the respiration. The chloroform was, in consequence, pushed much further than it should have been, and the animal died sooner than was intended.

These cases are of themselves quite sufficient to show that animals are just as liable to death from the careless administration of chloroform as human beings; and the accidental deaths which occurred during the experiments of the Commission afford the best possible proof that the effects of chloroform are identical in the lower animals and in the human subject. The statement so frequently made, that dogs are more resistant to chloroform than human beings, is entirely incorrect.

METHOD OF EXPERIMENTATION.

ADMINISTRATION OF ANÆSTHETICS.

For experiments on the general action of chloroform the animal was usually placed upon a table and held by several assistants. An inhaler, consisting of a conical bag of cloth containing a sponge or absorbent cotton-wool with the anæsthetic, was then placed over the animal's mouth and nostrils, and kept there as long as necessary. While one observer watched for the loss of reflex from the cornea, the cessation of respiration, stoppage of the pulse, and arrest of the heart, another seated at an adjoining table with a watch before him noted down the times at which each event occurred. The corneal reflex was ascertained by simply touching the cornea with the finger or a blunt instrument, such as the point of an aneurysm needle. The cessation of breathing was ascertained by simple ocular inspection of the thorax and diaphragm, the presence or absence of the pulse by feeling the femoral artery with the finger, and the entire stoppage of the heart's action by watching the movements of a needle pushed through the thoracic walls into the heart. The movements of this needle were rendered more evident by a straw bearing a small paper flag being fixed to the end which projected outside the thorax. Animals anæsthetised by this method struggled while they were held until the anæsthetic had had time to take effect. In order to avoid struggling another method was adopted. This consisted in simply lifting the animal into a wooden box 3 ft. 10 in. long by 1 ft. 5 in. broad, and 1 ft. 7 in. deep, and putting on the lid, in which was an opening. Through this opening was passed a large piece of blotting-paper on which half an ounce or more of chloroform had been poured. A piece of wood or glass was then placed over the opening in the lid, and in a short time the anæsthetic took effect. To prevent too large admixture of air a strip of spongio-piline was nailed round the edges of the box and covered with vaseline, so that the lid shut down air-tight. Even when a piece of wood was used to close the aperture in the lid at first it was usually replaced by glass, when the chloroform began to take effect, as the movements of the animal could thus be watched. When it fell down insensible it was usually taken out at once, and if prolonged anæsthesia was required, as for blood-pressure experiments, an additional quantity of the anæsthetic was administered on a cap.

ADMINISTRATION OF DEFINITE PROPORTIONS OF CHLOROFORM VAPOUR.

In order to make animals respire air charged with definite proportions of chloroform vapour, the following methods were used.

(a) A certain quantity—e.g., $\frac{1}{2}$ oz., 1 oz., or 2 oz. of chloroform was poured on blotting-paper in the box already described, and when it was seen through the glass in the lid that evaporation was complete, the lid was lifted, the animal introduced, and the lid quickly replaced. The box contained almost exactly eight cubic feet of air, so that the proportion of chloroform vapour in it was easily reckoned. As the whole of the chloroform was evaporated before the animal was introduced, the alteration which its bulk produced in the air-content of the box did not affect the proportion of vapour.

(b) But in the process of opening the box and introducing the animal there was almost inevitably some disturbance of the air charged with chloroform which the box contained. In order to avoid this, a box of tin plate the same size as the last was taken, and a round opening 5 in. in diameter was made in one end near the bottom. Round this a collar of tin plate $\frac{1}{2}$ in. in depth was soldered, and on the top of the box was another opening 8 in. long by 5½ in. broad covered by a tin lid. The chloroform was introduced by the opening on the top, and allowed to evaporate

²⁸ Vide Experiment 45. ²⁹ Vide Experiments 47 and 52.

³⁰ Vide "Snow on Anæsthetics," page 123.

³¹ It may be noted that 109 pints of chloroform and 11 pints of ether were used during the experiments of the Commission.

as before, and the animal's head was then introduced through the opening at the end and made as nearly as possible air-tight by a piece of mackintosh fastened to the tin collar surrounding the opening, and tied round the animal's neck.

(c) When it was thought desirable to make the animal inspire a definite proportion of chloroform vapour through a tracheal cannula, the same apparatus as above described was used, but in one end of the box two tin tubes were fixed each $\frac{3}{4}$ in. in diameter. These were connected by indiarubber tubing of a similar bore to the arms of a tin Y tube. The leg of this tube was connected with indiarubber tubing to a glass cannula tightly tied into the trachea. By means of indiarubber valves the current of air was made to circulate always in one direction.

(d) When it was desired to insufflate the animal's lungs with air containing a definite proportion of chloroform vapour, the apparatus just described was employed with the addition of a bellows, which drew the air from the box. In the valve-hole of the bellows a $\frac{3}{4}$ in. tube was fixed by means of a large cork bung. This tube was connected by a $\frac{3}{4}$ in. indiarubber tubing with one of the tubes in the end of the box already described, and by the Y tube with the tracheal cannula. A valve over the nozzle of the bellows and another on one arm of the Y tube regulated the direction of the current of air. These valves consisted simply of a piece of dentists' sheet rubber tied loosely over the end of the nozzle or tube and then cut across. When the air passed in one direction—e.g., from the bellows—it blew open the edges of the cut rubber, but when it tried to pass in the opposite direction the edges of the rubber fell together and presented a considerable obstacle.

ADMINISTRATION OF DEFINITE QUANTITIES OF CHLOROFORM.

For the purpose of giving a definite quantity of chloroform with unlimited quantity of air another apparatus was used. It consisted of a wide-necked jar 7 in. deep by $5\frac{1}{2}$ in. internal diameter. The top was closed by a tightly-fitting bung, in which there were three apertures. In two of these were fixed $\frac{3}{4}$ -in. glass tubes, and the third was closed by a small stopper, which could be withdrawn at will for the purpose of introducing chloroform into the bottle. To one of these tubes a valve was attached which only allowed the air to enter the bottle, but prevented its exit. The other tube was connected by wide rubber tubing with a tin inhaler. This inhaler was in the form of a truncated cone, and had two $\frac{3}{4}$ -in. tubes opening into it. One of these was at the apical end and the other at the side of the inhaler. The apical tube was connected with the bottle just described. The side tube was closed by a simple valve consisting of a perforated cork, over which a strip of thin sheet rubber was loosely fastened. At each expiration the rubber allowed the air to escape freely, but at each inspiration it closed completely. The muzzle of the animal was inserted in the inhaler, and a piece of mackintosh was tied round the inhaler and the head of the animal by means of an elastic bandage, so that the inhaler was nearly air-tight. On inspiration the air passed through the glass cylinder, becoming partially charged with chloroform on its way, and during expiration it passed out through the side tube of the inhaler.

For the purpose of keeping up artificial respiration an ordinary bellows was employed, but to the nozzle of it was fixed a valve which closed when the bellows was pressed, and thus directed the air into the lungs, but opened as the bellows expanded, and thus allowed the air to escape from the lungs. This valve consisted of a T tin tube $\frac{3}{4}$ in. in diameter. One end of its transverse limb was connected with the nozzle of the bellows, the other with the tracheal cannula. The opening of the perpendicular limb was covered by a piece of tin plate mounted on a hinge in such a way that when the bellows was pressed a cord tied to the upper handle of the bellows pulled it down and closed the opening, but during the expansion of the bellows it was raised and the opening uncovered by the elastic force of a piece of indiarubber. The cord and indiarubber were both attached to a short rod fixed at right angles to that which carried the cover. When it was desired to give chloroform vapour along with the insufflated air, a piece of blotting-paper soaked with chloroform was held over the valve opening of the bellows, or the opening

was closed by a bung and wide rubber tube, and the blotting-paper was placed inside the tube. In the first comparative experiments on the effects of chloroform and ether on the heart in monkeys, when given by insufflation, the bellows and valve just described was employed. Instead of one limb of the T tube being directly connected with the tracheal cannula, however, it was connected to a small glass T tube. Each of the other limbs of this tube passed to a long-necked glass flask furnished with a tubulature through which the anæsthetic could be introduced. The neck of the flask was closed by a stopper through which two glass tubes passed, one reaching only a little way below the stopper, but the other extending nearly to the bottom of the flask. One of these tubes was connected with the glass T tube just mentioned, and the other with a glass cannula tightly tied into the trachea. At each blast of the bellows the air passed onward through these glass flasks to the tracheas of the animals, and returned through the flasks and out through the valve during the expansion of the bellows. It is evident that by this arrangement a certain admixture of ether and chloroform vapour will occur in the tubes between the animals and the valve, so that after a few blasts both animals will receive mixed vapour, although that of chloroform will predominate in the one case and that of ether in the other. In order to avoid this admixture the bellows was used without the valve, and provision was made for allowing the air to escape from the lungs by using a different form of tracheal cannula. Instead of a plain glass tube a small glass T tube was used. The perpendicular limb was inserted into the trachea, and one end of the horizontal limb was connected with the bellows; the other was partially closed by a piece of glass tubing, one end of which was drawn out and cut off so as to leave only a small orifice. This was attached by a short piece of indiarubber tubing to the limb of the T tracheal cannula. The orifice was of such a size that while it presented sufficient resistance to the passage of air to allow the lungs to become completely inflated when the bellows was pressed, yet during the expansion of the bellows it allowed the air to escape from the lungs and thus prevented over-distension.

When it was desired to give vapour by insufflation to one small animal, such as a monkey or rabbit, only the indiarubber ball of Junker's apparatus was used instead of the bellows. Junker's apparatus consists of the indiarubber balls ordinarily used for spray producers, but these are attached to a bottle in which the anæsthetic is put in such a way that, instead of producing spray, the air simply passes through the anæsthetic and becomes charged with the vapour. It then passes to a mouthpiece and is inhaled. The mouthpiece which we employed for dogs was made of stout leather in the form of a truncated cone. A metal tube $\frac{1}{4}$ in. in diameter, opening into the inhaler at its apical end, conveyed the vapour into it. This tube fitted the opening in the inhaler, through which it passed closely, but the junction was not air-tight. The inhaler at its other end did not fit the dog's muzzle at all closely, so that there was a free circulation of air. When we wished to prevent this, and to give concentrated vapour, a piece of mackintosh was tied over the inhaler and muzzle so as to close up the space between them.

BLOOD-PRESSURE EXPERIMENTS.

In all these experiments the pressure within the arteries was registered by one of Ludwig's kymographs consisting of a mercurial manometer and a revolving cylinder on which the oscillations of the mercury were recorded. The paper on the cylinder was smoked by means of burning camphor. The float on the mercury of the manometer consisted of a cylindrical piece of ivory tapering below and bearing above a steel wire, near the top of which a writing point of glass was fixed by a bit of cork. This point was kept in contact with the smoked paper by a silk thread loaded with a shot. To the top of the manometer was fastened a second writing point made of glass or of copper foil. When the mercury was at zero this point was at the same level as the point on the float, and as the cylinder revolved it traced the zero line round it, and thus afforded a means of estimating the height of the blood pressure at any moment. The cylinder revolved once in nearly thirty minutes. Near the top of the cylinder was placed a magnetic time-marker worked by a Du Bois Reymond's key.

An observer sat constantly beside the cylinder with a watch in front of him, and recorded on the cylinder by means of the time-marker, as well as the instant when any-

thing worthy of note occurred, the time, minute by minute. When the revolution of the cylinder or drum was complete it was removed, and a second drum, which was kept ready smoked, was substituted. The tracing on the first drum was at once cut off and varnished, and another paper put on and smoked, so as to be in readiness when required.

The movement of the cylinder in these experiments is much slower than that usually employed, but it has the double advantage of allowing the whole record of the experiment to be reproduced, and of rendering distinct even small variations of pressure which are apt to escape observation in the long tracing taken on a rapidly revolving drum. But the tracing taken on such a slow drum as we employed has the disadvantage of being so compressed that the individual pulse beats are invisible.

To obviate this defect a method of double registration was adopted, which had been devised by one of us for a previous research. In the connexion between Ludwig's kymograph and the artery a Y tube was inserted, by means of which a second kymograph, the cylinder of which revolved once in three minutes nine seconds, or about ten times as rapidly as the first, could also be brought into communication with the artery. Both were provided with stopcocks, so that they might either be allowed to work simultaneously, or the communication of either or both with the artery cut off at will. If a mercurial manometer had been used in the second kymograph it would have given the number of pulse beats, but the oscillation of the mercury itself would have modified their size and form. One of Fick's spring manometers was therefore used, and, in order to prevent the oscillations of the mercury in the other manometer affecting Fick's, the stopcock connecting the former with the artery was almost always turned off when the latter was turned on. This plan had the further advantage that the straight line traced by the float of Ludwig's kymograph attracts the eye so that a glance at the tracing at once shows when a tracing has been taken by Fick's manometer, and, by attaching corresponding numbers to these blanks in the tracing from Ludwig's kymograph and the tracings by Fick's kymograph, the relation of the tracings to each other can be at once ascertained. The clockwork of Fick's kymograph was usually started at the moment when the stopcock connecting it with the artery was opened. A short time is required for the clockwork to attain its full speed, and therefore at the beginning of a tracing the oscillations may be closer together, and the pulse may appear to be quicker at the beginning than the end of the reading of Fick's kymograph, although the pulse rate might be really the same throughout. The cylinder was usually, though not always, allowed to revolve a little space after the connexion of the manometer with the artery had been cut off in order that the readings might be more distinctly separated from one another. The mercurial manometer was connected with the artery partly by metal and partly by indiarubber tubing. The Fick's manometer was connected entirely by indiarubber tubing in the experiments up to November 5th, but after that the connexion was made partly by indiarubber and partly by metal, exactly as in the Ludwig's. The whole of the connecting tubes, except those between the Y tube and the manometers where water was used, were filled with a solution of sodium bicarbonate in order to prevent coagulation occurring in them.

This solution was made by saturating boiling water with sodium bicarbonate and then boiling it for some minutes, so as partly to convert it into carbonate. It was then allowed to cool, and was poured into a large glass vessel furnished with a tubulature near the bottom, and suspended on the wall of the room at a height of 7 ft. from the floor and $4\frac{1}{2}$ ft. above the level of the table. From the tubulature of this vessel the solution was conveyed by indiarubber tubing to a glass T-piece inserted in the connection between the manometers and the artery. By means of clamps the soda solution

could be passed at will through the tubes leading to the artery. Before beginning an experiment the pressure within the manometer was raised by means of the soda solution to a height approximating to the estimated blood pressure in the animal, so as to prevent the blood from passing too far up the tubes and forming clots. This was also done whenever the artery and manometer had to be disconnected on account of clots having formed. In order further to lessen the tendency to form clots an elongated glass bulb was introduced into the tubing, and was connected by a short piece of indiarubber tube with the glass cannula in the artery. The cannulas used for insertion in the artery were blown with a short neck to hold the ligature and prevent the cannula from slipping out of the artery. They were of various sizes so as to fit the artery of the animal experimented on. In all the experiments with one exception, the animal was first rendered insensible by being placed in a box with chloroform, as ether given in this way would have been useless. As soon as it became insensible it was taken down and the legs fastened with cords to a simple piece of board 4 ft. 6 in. long by 2 ft. 2 in. broad. To one end of this one of Bernard's dog holders was attached, and in this the animal's head was put so as to hold it still. Chloroform or ether was then administered on a nose-cap as required to keep the animal anaesthetised and one carotid exposed, the left being selected in every case as it was nearest to the manometer. Occasionally one or both vagi were also exposed and a loop of thread placed under them, but not tightened round them.

The artery was firmly ligatured on its distal side, and the proximal side was compressed by spring forceps covered with indiarubber tubing to prevent their injuring the coats of the artery. The artery was then opened, the cannula inserted, and firmly tied in. The cannula was then filled with soda solution by means of a pipette, and connected with the glass bulb, already mentioned, care being taken that no air bubbles were present. The spring forceps were then removed from the artery, the stopcock of the manometer turned so as to open the connexion with the artery, and the tracing commenced. All this time the animal was kept unconscious by the administration of an anaesthetic from time to time as required.

REGISTRATION OF THE MOVEMENTS OF THE HEART.

These were sometimes registered by inserting a needle into the heart, and connecting a thread to the end which projected outside the thorax when this was unopened, or outside the cardiac walls when the thorax was opened and the heart exposed. This thread was in the first instance tied to the lever of a Marey's tambour A, and the movement transmitted by it to a second one (B), which recorded it. The resistance of the two tambours, however, was too great, and the tracings obtained were unsatisfactory. Better results were obtained by connecting the needle in the heart with a time-marker by means of two very light wooden pulleys. The lever of the time-markers being kept up by a very fine spring, a very slight pull sufficed to depress it, and thus it marked even when the cardiac action was weak, and had the further advantage of opposing very little resistance to the action of the heart.

REGISTRATION OF THE RESPIRATION.

For this purpose the two Marey's tambours A and B were used. A was usually connected to a needle pushed through the chest walls into the diaphragm. On one or two occasions an incision was made just under the margin of the ribs, and a piece of thick copper wire, flattened at one end, was introduced, so that the flat pieces lay between the diaphragm and liver. The other end projected outside, and the thread from Marey's tambour was fastened to it. In some of the later experiments a fish-hook was used instead of a needle. [The tabulation of the experiments to which reference is made above is here appended. The manometer experiments will be found on p. 36.]

EXPERIMENTS CONDUCTED BY COMMITTEE.

Date.	No.	Description of dog.	Time at which inhalation commenced	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Oct. 23	1	Full-grown well-nourished pariah.	2 51 0	0 2 0	0 3 20	0 3 55	0 3 55	2 54 55	0 3 0	The chloroform administered freely on a cloth cap with a sponge inside. The respiration was in mere gasps for some time before its final cessation. The dog continued to yelp for some time after the cornea became insensible. Artificial respiration for three minutes failed to restore the pulse or respiration. P.M.: Lungs healthy. Pulmonary veins much distended. Right auricle and ventricle full of blood. Left side empty. A leather muzzle was used to control the dog, which probably caused some constriction of the neck. Temperature of room 25.5° Cent.
Do.	2	Ditto.	3 9 25	0 2 0	0 3 10	0 3 30	0 3 45	Not employed.	...	Chloroform administered as in No. 1. Leather muzzle as above. P.M.: Conditions the same as in No. 1.
Do.	3	Ditto.	3 26 0	0 0 43	0 1 50	0 3 23	0 3 45	Do.	...	Chloroform as in No. 1. In place of the leather muzzle a simple loop of rope was fastened round the jaws and tied behind the ears until the dog became quiet, so that no pressure was exercised upon the neck. The dog continued to yelp and groan for 47 seconds after the cornea became insensible. P. M.: Both sides of the heart full of blood. Lungs normal.
Do.	4	Ditto.	3 44 40	0 1 3	0 1 28	0 1 50	0 2 10	3 49 10	0 2 0	Chloroformed freely, as in No. 1. The dog breathed more deeply than his predecessors. P.M.: Right side of the heart full of blood; left side moderately so. Lungs normal.
Do.	5	Ditto.	4 9 40	0 1 40	0 3 35	0 4 0	0 7 0	4 17 0	0 1 15	Chloroform in $\frac{1}{2}$ -drachm doses on the same cap, five doses in all. Inhaled freely. Yelped a little after cornea became insensible. P.M.: Lungs healthy; right ventricle distended with venous blood; left ventricle half full of bright arterial blood.
Do.	6	Ditto.	4 24 10	0 1 10	0 5 13	0 5 55	0 7 5	Not employed.	...	Chloroform in $\frac{1}{2}$ -drachm doses, as in No. 5—five doses in all. Continued to yelp loudly after cornea became insensible. P.M.: Conditions as in No. 5.
Do.	7	Full-grown well-nourished pariah, two hours after a full meal.	9 45 0	0 0 50	0 2 55	0 4 15	0 6 50	Do.	...	Chloroformed freely in the ordinary hospital way. No muzzle used. Continued yelping 1 m. 20 s. after cornea became insensible. One heaving respiration occurred about 50 s. after the respiration was considered to have ceased. Veins of the brain full. Structure normal. Right auricle and ventricle distended. Left side almost empty.
Do.	8	Ditto.	10 8 0	0 0 40	0 1 10	0 3 30	0 5 7	Do.	...	Chloroformed fully. No muzzle used. Respiration was thought to have ceased at 1 m. 10 s., but subsequently returned and continued until 3 m. 20 s., as noted in the table. The pulse similarly appeared to have ceased at 1 m. 50 s., but returned and continued until 3 m. 30 s. after the commencement of inhalation. No yelping or groaning. Both ventricles moderately firmly contracted. Right auricle distended.
Do.	9	Ditto.	10 17 35	0 1 53	0 3 30	0 4 10	0 5 40	Do.	...	Chloroformed fully. No muzzle used. Respiration stopped after 2 m. 40 s., after which there were only three gasps, and it finally ceased at 3 m. 30 s., as noted in the table. Pulse stopped after 3 m. 20 s., but returned and continued for 4 m. 10 s., as noted. Groaning continued for 2 m. 35 s.
Do.	10	Full-grown pariah (light meal only at 7.30).	10 9 40	0 5 25	0 9 50	0 11 25	0 13 53	Do.	...	Dog enclosed in a box 42 $\frac{1}{2}$ in. by 19 in. by 17 $\frac{1}{2}$ in. (8 cubic feet contents), which was opened occasionally in order to examine the dog, and chloroform given fully on a piece of blotting-paper placed under the lid. No struggling or excitement. Removed from the box after 6 m., and chloroform administered on a cap as before. Respiration ceased after 6 m. 15 s., but feeble occasional movements continued without probably any entrance of air into the chest for 9 m. 50 s. Heart as in previous cases. Blood in left ventricle rather venous in character.
Do.	11	Ditto, just caught.	10 48 50	0 7 0	0 9 42	0 16 30	0 18 0	11 7 15	0 2 0	Dog enclosed in the same box and chloroform administered as in No. 10. No excitement, the dog lying down quietly after about 4 m. Removed from the box after 8 m. 30 s. and

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1839.										chloroform administered on a cap as before; but the sponge was not pushed up close to nose, so that the vapour was not so concentrated as in the previous cases, and the last air which entered the lungs therefore contained a less proportion of chloroform. Both ventricles full, but not distended. The blood in the right ventricle dark; that in the left ventricle arterial, but not bright red.
Oct. 23	12	Full-grown pariah, rather thin.	11 17 50	0 4 10	0 5 53	0 12 35	0 16 0	11 33 40	0 2 0	Dog in box as before, but with a small opening covered with a glass lid, in order to observe movements. No excitement. Removed from box at 4 m. 30 s., and chloroform administered on a cap as in No. 11. Chest opened after 14 m., so that heart's movements could be seen. Only flickering contraction for last two minutes, after which the trachea opened and lungs inflated by means of bellows, but no restoration of heart's movements occurred, although it was stimulated by pressure.
Do.	13	Full-grown pariah brought in 3 hours before; no food since arrival.	11 40 50	0 4 28	0 5 50	0 7 7	0 8 30	11 48 40	0 1 50	In box as before. No excitement. Dog fell down in box at 11 h. 44 m. 8 s. Removed after 4 m. 30 s., and chloroform administered as before. Chest opened at 11 h. 48 m. 40 s. The heart only feebly flickering for half a minute.
Do.	14	Full-grown but rather small-sized pariah; dog rather thin; no food.	2 45 50	0 4 55	0 10 47	0 12 27	0 12 54	...	...	The dog in the same box, but excited by putting crackers inside the box and hammering it outside. Chloroform as before freely on blotting-paper inside the box. Dog fell down after 3 m. 45 s. Removed from the box after 5 m. 45 s., and chloroform administered on a cap as before. Respiration very slow after 8 m. A few flickering movements of chest wall after respiration had practically ceased. Heart as in No. 11. Blood rather venous on left side.
Do.	15	Large-sized, full-grown pariah; not fed recently.	3 2 25	0 4 15	0 8 10	0 9 32	0 10 19	...	...	The dog in box and excited by crackers as in No. 14. Dog fell down after 1 m. 50 s., but continued to struggle. Dog removed from box after 4 m. 50 s. and chloroform continued as before. Breathing very shallow after 7 m., hardly more than flickering movement of the chest wall. Post-mortem condition the same.
Oct. 24	16	Small-sized but fully grown pariah just brought in.	3 17 50	0 6 55	0 15 50	0 17 40	0 18 11	...	...	Dog in the same box, only without agitation. Chloroformed as in previous cases. Removed from the box after 7 m. 5 s., and chloroform continued as before. Evulsion of the nails performed after 9 m. 17 s., and while respiration continued. No apparent effect on the pulse in femoral artery. Internal rectus muscle cut through after 13 m. 40 s. Pulse did not intermit during operation, but was felt to be hard and cordy. This condition had not been previously observed. Chloroform temporarily interrupted during operation. Pulse became feeble and intermittent after 15 m. 5 s.
Oct. 25	17	Full-grown, well-nourished dog fed with beef-tea about a quarter of an hour previously.	9 30 15	0 4 15	0 6 5	0 7 12	0 7 50	...	0 34 5	A very little almost venous blood in the left ventricle. Right side full. Liver very much congested; the large veins of the splanchnic area engorged, but venous radicles almost empty.
Do.	18	Full-grown pariah.	9 49 20	0 1 22	0 2 30	0 4 0	0 4 22	...	...	In the same box, but this had been made more air-tight. Chloroform fully on blotting-paper. No excitement, the dog lying down after 3 m. 50 s. and rolling about from side to side. Convulsed violently at 4 m. Taken out of the box at 4 m. 45 s. and chloroformed with the ordinary cap. Respiratory movements and heart sounds both feeble at that time. Post mortem: Heart structure normal.
Do.	19	Full-grown, well nourished pariah.	9 57 27	Not observed	0 4 38	0 5 38	0 7 10	...	...	Chloroformed on the table with cap in the ordinary way. Pulse only flickering after 3 m. 29 s. No excitement and very little struggling. Heart healthy; both sides moderately full; that on left side rather venous in colour.
										In the box with 2 oz. chloroform on a towel put into the box with the dog. Dog fell down after 2 m. 40 s. and struggled violently. Respiration shallow after 3 m. 30 s. Taken out of box when pulse stopped. Heart healthy, and in the same condition as the last. Liver very congested.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Oct. 25	20	Full-sized, well-nourished dog.	H. M. S. 10 10 55	H. M. S. Not observed.	H. M. S. 0 2 52	H. M. S. 0 4 35	H. M. S. 0 4 45	H. M. S. ...	H. M. S. ...	Two ounces of chloroform introduced on blotting-paper into the box and allowed to completely evaporate before the dog was put in. Sat down after 1 m. Fell down after 2 m. * Taken out after 3 m. 45 s., as the pulse had stopped, but it returned and flickered for nearly another minute. Heart as before; liver very congested; veins of the splanchnic, including the venous radicles, engorged. Box prepared as in the last, but with only one ounce of chloroform. Dog introduced when the blotting-paper appeared dry as in No. 20. Fell down after 1 m. 40 s. Struggling after 2 m. Breathing laboured after 2 m. 30 s.; shallow after 3 m. 35 s. Jerking of the thoracic wall merely at 5 m., but afterwards breathing more regularly and deeply, lying quietly at the bottom of the box. Box opened at 11.46, freely aired, another ounce of chloroform placed inside on blotting-paper. Cornea now quite insensible. When respiration had ceased the dog was removed from the box; no pulse could be felt or heart sound heard.
Do.	21	Small, badly nourished pariah.	10 27 25	Ditto.	...	...	...	...	...	Chloroformed with Junker's inhaler, no muzzle, the ball being compressed 20 times in a minute. Struggled a little at first, cornea becoming insensible very gradually. Breathing ceased at 12 m. 38 s., but returned at 14 m. 30 s., the pulse during this interval being very rapid. Respiration then very shallow, but continued until 19 m. 24 s. after the commencement of inhalation. Four drachms of chloroform used. Heart, liver, and venous radicles as in No. 20.
Do.	22	Full-sized, fairly nourished pariah.	10 50 33	0 12 25	0 19 24	0 21 30	0 22 15	...	...	Chloroformed with Junker, squeezing rapidly so as to keep the second ball distended. Respiration stopped at 4 m. 26 s.; but, the chloroform being discontinued to listen to heart, the respiration returned, and finally ceased after 7 m. 32 s. Left side of heart almost empty and otherwise as in No. 23. 2½ drachms of chloroform used.
Do.	23	Half-breed spaniel pariah, badly nourished.	11 27 33	0 2 32	0 5 18	Not noted exactly.	0 8 5	...	...	Manometer experiment.
Do.	24	Half-breed black-and-tan pariah, well nourished.	11 47 20	0 1 27	0 7 32	0 7 49	0 9 0	...	...
Do.	25	Full-sized, strong pariah.	2 25 10	...	...	...	...	...	...
Oct. 26	26	Full-sized pariah (brown), fairly nourished.	7 44 0	...	8 32 1	8 34 0	No cessation.	Employed, but not timed.	...	Box, 8 feet cubic contents, prepared as in No. 21, with 8 drachms of chloroform fully evaporated before the dog was put in. Transferred at 8 h. 19 m. 30 s. into another box of 9½ cubic feet contents prepared in the same way, before the dog was put into it, with 9½ drachms of chloroform, so that the proportion of vapour was equal in the two boxes. Removed from box at 8 h. 32 m. Heart beating very fast, but no pulse could be felt. Breathing returned in a few minutes, but stopped again, and was only fully restored after artificial respiration had been employed. Dog fell down at 7 h. 53 m. Box changed at 8 h. 19 m. 30 s.
Do.	27	Same dog.	8 52 0	...	9 29 0	9 31 30	9 31 50	Not employed.	...	Repetition of the last experiment with the same dog, which was still drunk from the previous experiment. Recovered. Respiration returned about 1 m. after the heart was supposed to have ceased beating. Respiration again stopped, 9 h. 35 m. 30 s. Breathing again 9 h. 37 m. 30 s. During this time the pulse had not stopped. Cornea sensible at 9 h. 38 m. 30 s. Respiration 34 per minute, and the dog fully recovered eventually. Was lying down at the commencement. Box changed at 9 h. 22 m.
Do.	28	Same dog.	10 44 0	...	11 35 0	11 35 0	...	...	...	Same boxes as in the last, with 8 drachms and 9½ drachms of chloroform respectively. Respiration gasping at 10 m. 48 s.; afterwards continuously, very feeble, but regularly. On respiration ceasing at 11 h. 35 m. he was taken out of the box; the pulse could not be felt, and the heart, which was beating very slowly, was thought to have stopped. He recovered, however, without artificial respiration, and commenced to breathe spontaneously at 11 h. 41 m. Dog fell down in box at 10 h. 47 m. 30 s. Box opened at 11 h. 23 m. 30 s.

* Nos. 29 to 185 were manometer experiments. (See pages 36, et seq.)

EXPERIMENTS CONDUCTED BY SUBCOMMITTEE.

I. (a).—Large doses of chloroform given till death occurred, the chloroform being administered on a cloth cap inhaler. Dogs taken without any preparation.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Oct. 24	186	Full-grown pariah, healthy.	2 18 30	0 1 50	0 3 10	0 3 50	0 4 50	...	...	Severe struggling, and had to be held down forcibly for the administration.
Do.	187	Full-grown healthy pariah.	2 28 30	0 0 36	0 1 15	0 3 16	0 4 3	...	...	Two gasps were made after respiration had ceased, but no air entered the lungs. Struggled severely, and had to be held down forcibly.
Do.	188	Ditto.	2 37 0	0 0 57	0 1 12	0 1 32	0 3 35	...	...	Severe struggling, and had to be held down forcibly.
Do.	189	Ditto.	2 48 10	0 0 40	0 2 0	0 2 23	0 4 37	...	...	Pulse returned for a few seconds before the heart stopped beating. Struggled a great deal.
Do.	190	Ditto.	2 56 10	0 1 4	0 1 44	0 2 4	0 4 13	...	...	Struggled severely. Gaspd six times after the respiration ceased.
Do.	191	Under-sized pariah.	3 8 50	0 0 37	0 1 15	0 1 23	0 4 20	...	...	Struggled severely.
Do.	192	Pariah puppy, nine months old.	3 16 10	0 0 36	0 1 37	0 1 56	0 5 23	...	...	Struggled severely. A few flickering beats were felt at the pulse when the dog gasped, which he did once before the heart ceased beating.
Do.	193	Full-grown, but small pariah.	3 23 4	0 0 48	0 3 50	0 5 43	0 8 27	...	...	Struggled severely. Gaspd twice before the heart stopped.
Do.	194	Full-grown pariah.	3 35 5	0 0 52	0 1 33	0 2 48	0 4 33	...	...	Struggled. Gaspd thrice before the heart stopped.
Do.	195	Ditto.	3 42 8	0 0 56	0 2 42	0 3 32	0 5 28	...	...	Struggled.
Oct. 25	196	Ditto.	9 49 0	0 0 50	0 1 25	0 2 4	0 3 42	...	...	Struggled.
Do.	197	Ditto.	10 6 4	0 0 46	0 1 13	0 2 25	0 4 19	...	...	Gaspd twice after the respiration ceased. Pulse stopped after 1 m. 50 s., and, with gasping, returned for 30 s. Stopped finally after 2 m. 25 s.

I. (b).—Dogs fed on Liebig's extract of meat a quarter of an hour before inhalation.

Do.	198	Large-sized, full-grown, healthy pariah.	10 12 8	0 0 51	0 2 52	0 3 44	0 5 15	...	...	Had Liebig's extract of meat, two teaspoonfuls in hot water, a quarter of an hour before inhalation. Gaspd four times, and pulse returned after 40 s. Pulse stopped again after 4 m. 45 s. Chloroform given as in the previous experiment.
Do.	199	Healthy, large-sized pariah.	10 27 12	0 1 8	0 2 10	0 2 54	0 4 32	...	...	Struggled. Had Liebig's extract of meat as in the above case.
Do.	200	Small-sized, healthy pariah.	10 38 2	0 1 4	0 1 22	0 3 41	0 4 14	...	...	Struggled. Gaspd before heart stopped beating. Ditto.
Do.	201	Full-grown, well-nourished pariah.	2 5 0	0 0 58	0 2 22	0 2 30	0 4 14	...	...	Struggled. Had Liebig's extract of meat as in the last case.
Do.	202	Ditto.	2 18 0	0 0 54	0 1 56	0 2 3	0 4 2	...	...	Struggled. Had Liebig's extract of meat as in the last case.
Do.	203	Ditto.	2 21 0	0 1 1	0 1 48 Gaspd from 1 m. 55 s. till 2 m. 9 s.	0 2 18 Pulse returned at 3 m. 10 s. till 3 m. 37 s.	0 4 17	...	...	Struggled. Respiration ceased after 1 m. 48 s. After 1 m. 55 s. gasped till 2 m. 9 s. Pulse ceased after 2 m. 18 s. Returned after 3 m. 10 s. and went on till 3 m. 37 s., when it finally stopped. Had Liebig's extract of meat as in the last case.
Do.	204	Full-grown, well-nourished, small-sized pariah.	2 29 0	0 1 20	0 4 17	0 5 2	0 7 34	...	...	Had Liebig's extract of meat as in the last case.
Do.	205	Full-grown, well-nourished, extra strong pariah.	2 41 0	0 0 50	0 1 20	0 1 22	0 1 22	...	...	In this case the dog, which was a very savage one, escaped twice before being chloroformed, and struggled very forcibly. He had to be brought into the room with a tight rope and chain round the neck, and was muzzled with the leather muzzle. The respiration ceased after 1 m. 20 s.; the muzzle and rope were removed as quickly as possible, but immediately afterwards, two or three seconds at most, the heart and pulse stopped simultaneously. It was impossible to perform ordinary artificial respiration, as no air could be forced in or out of the lungs. Post mortem: Lungs engorged, right and left ventricle of heart engorged and distended with dark venous blood. Post-mortem appearances indicate death from asphyxia pure and simple. Liver contained less blood than usual, and it did not flow on section. Had Liebig's extract of meat as in the last case.

I. (c).—Dogs kept fasting for twenty-four hours.

Oct. 26	206	Full-grown, healthy pariah, well nourished.	8 30 0	0 1 47	0 2 50	0 3 22	0 7 44	Struggled severely. Gaspd several times in the interval between the stoppage of pulse and heart, and the pulse returned for 1 m. 35 s. (The chloroform in this and the following cases was given on the cloth cap inhaler.)
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Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Oct. 26.	207	Full-grown pariah puppy, badly nourished.	8 43 0	0 1 9	0 2 13	0 3 23	0 6 35	...	...	Struggled severely. Gaspd five times before heart stopped. Pulse returned for 30 s. before heart stopped acting.
Do.	208	Full-grown, well nourished pariah.	8 54 0	0 1 40	0 3 0	0 8 0	0 8 48	...	...	Struggled severely. Gaspd several times before heart stopped.
Do.	209	Badly nourished, full-grown, small-sized pariah.	9 9 10	0 1 7	0 3 4	0 4 6	0 6 23	...	...	Struggled severely. Dog gaspd six times before heart ceased to beat.
Do.	210	Ill-nourished, full-grown pariah.	9 21 0	0 1 33	0 3 43	0 4 20	0 9 16	...	...	Struggled severely.

I (d).—Dogs that have had rectified spirit before inhalation. Chloroform in large doses on cloth cap inhaler.

Do.	211	Full-grown, healthy pariah.	10 42 0	0 0 50	0 3 2	0 3 48	0 6 18	...	...	Struggled. Had $\frac{1}{2}$ oz. of spiritus rectificatus immediately before the inhalation.
Do.	212	Large-sized, unusually strong pariah.	10 58 0	0 0 44	0 2 34	0 2 54	0 5 4	...	...	A small dose of chloroform was given preparatory to the administration of the spirit, as there was difficulty in getting him to swallow it without the anæsthetic.
Do.	213	Full-grown, badly nourished pariah, with a healing wound on left side of thorax.	11 15 0	0 2 22	0 3 51	0 4 15	0 6 28	...	...	Had $\frac{1}{2}$ oz. of spiritus rectificatus with water four minutes before the inhalation. Little or no struggling.
Do.	214	Full-grown, badly nourished, weak pariah (emaciated).	11 24 10	0 1 33	0 8 23	0 9 15	0 12 46	...	...	Had $\frac{1}{2}$ oz. of spirits and water ten minutes before the inhalation, which made it drunk a minute after, and inhaled the chloroform quietly, with little or no struggling. No force was required to compel this animal to inhale, and there was no holding of the breath as in the cases where no spirit was administered, or it was administered immediately before the inhalation.
Do.	215	Full-grown, well-nourished pariah.	11 50 0	0 1 2	0 3 20	0 4 6	0 6 20	This dog struggled a great deal, although it had had $\frac{1}{2}$ oz. of spirits ten minutes before the inhalation, as in the last case.

I. (e).—Five dogs that have had two teaspoonfuls of Liebig's extract of meat two hours before the administration of chloroform in large doses.

Do.	216	Full-grown, healthy pariah.	2 30 0	0 0 42	0 1 22	0 1 38	0 4 18	...	...	Struggled a great deal. Inhaler was covered by mackintosh in this case to exclude air. Had extract of meat. The chloroform in this and the following cases was given as in the previous experiments.
Do.	217	Full-grown, healthy pariah, unusually strong.	2 49 30	0 0 53	0 1 40	0 2 8	0 4 46	...	...	Struggled a great deal. Pulse returned for 8 s. after it had stopped. Had extract of meat. Chloroformed in the same way.
Do.	218	Full-grown, ill-nourished pariah.	3 3 0	0 1 12	0 2 25	0 2 41	0 5 9	...	...	Struggled severely. Pulse returned for 17 s. before the heart stopped. Had extract of meat. Chloroformed in the same way.
Do.	219	Full-grown, healthy, well-nourished pariah.	3 17 0	0 1 48	0 3 0	0 3 38	0 6 17	...	...	Struggled severely. Had extract of meat. Chloroformed in the same way.
Do.	220	Large-sized, powerful pariah.	3 27 0	0 1 23	0 2 37	0 4 5	0 6 58	...	...	Struggled severely. Gaspd, and the pulse returned for 40 s. before the heart stopped. Had extract of meat Chloroformed in the same way.

I. (f).—Five dogs that have had food two hours previously to inhalation and chloroformed in the above manner.

Do.	221	Small-sized but full-grown and healthy pariah.	3 39 0	0 1 10	0 2 6	0 3 12	0 6 54	...	...	Struggled. Gaspd after pulse stopped, and the pulse returned for 15 s. before the heart stopped. Had food two hours before.
Do.	222	Full-grown healthy pariah.	3 49 10	0 1 10	0 2 22	0 3 17	0 6 38	...	...	Struggled very hard. Pulse returned for 28 s. after it had stopped. Had food two hours before.
Do.	223	Lean, but full-grown pariah.	4 10 54	0 1 4	0 1 43	0 3 5	0 4 36	...	...	Struggled. Gaspd after breathing had ceased. Had food 2 h. before inhalation.
Do.	224	Old and large-sized pariah.	4 20 40	0 0 58	0 2 0	0 2 33	0 5 43	...	...	Struggled a great deal. Pulse returned for 30 s. after it had stopped. Had food two hours before.
Do.	225	Well-nourished, full-grown pariah, unusually strong.	4 30 6	0 0 49	0 1 2	0 2 15	0 3 0	...	...	Struggled very hard, and was choked in being brought up to the table. Had food two hours before.

1. (g).—Dogs kept fasting from the previous evening chloroformed with large doses as usual.

Date.	No	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1389. Oct. 28	226	Full-grown, well-nourished pariah.	10 18 40	0 1 20	0 2 5	0 3 20	0 8 20	...	...	Dog struggled very much during inhalation. Chloroformed fasting. The chloroform was given, as in the previous cases, on a cloth cap inhaler.
Do.	227	Under-sized, fairly-nourished pariah.	10 32 8	0 0 57	0 1 22	0 2 2	0 6 42	...	...	Dog did not struggle much. Chloroformed starving.
Do.	228	Large-sized, full-grown, powerful pariah.	10 51 10	0 1 12	0 2 23	0 4 26	0 6 28	...	...	Struggled hard. Gaped after pulse stopped. Pulse returned simultaneously for 40 s. Chloroformed starving.
Do.	229	Large-sized, full-grown pariah.	11 1 48	0 0 45	0 3 14	0 4 4	0 6 42	...	...	Struggled hard. Chloroformed starving.
Do.	230	Large-sized, full-grown, but ill-nourished pariah.	11 12 30	0 1 35	0 1 48	0 2 18	0 5 12	...	...	Struggled hard. Gaped, and pulse returned for 1 m. and 5 s. before heart ceased contracting. Chloroformed fasting.
Do.	231	Badly nourished, full-grown pariah.	11 23 6	0 1 23	0 6 18	0 7 11	0 9 3	...	...	Struggled a little. Chloroformed fasting.
Do.	232	Large-sized, full-grown pariah.	11 45 15	0 2 6	0 2 49	0 3 13	0 5 12	...	...	Struggled very hard. Gaped after respiration ceased. Pulse returned for 23 s. Chloroformed fasting.
Do.	233	Large-sized, powerful pariah.	11 55 0	0 1 3	0 1 23	0 1 53	0 3 13	...	...	Struggled very hard. Chloroformed fasting.
Do.	234	Full-grown pariah, well nourished.	3 3 30	0 1 14	0 1 45	0 2 20	0 6 28	...	...	Ditto ditto ditto
Do.	235	Full-grown, healthy, well-nourished pariah.	3 19 0	0 1 1	0 1 55	0 3 17	0 4 37	...	...	Struggled very hard. Chloroformed fasting.
Do.	236	Weakly pariah puppy, eight months old.	3 28 0	0 1 45	0 2 48	0 3 23	0 6 12	...	...	Struggled feebly. Chloroformed fasting.
Do.	237	Ditto.	3 38 0	0 0 39	0 1 48	0 3 12	0 4 13	...	...	Ditto ditto
Do.	238	Lean, full-sized, ill-nourished pariah.	3 47 45	0 0 57	0 2 14	0 3 26	0 5 27	...	...	Struggled hard. Gaped several (13) times, when the pulse returned for 23 s. Chloroformed fasting.
Do.	239	Lean and full-grown pariah pup, about nine months old.	3 56 20	0 1 11	0 2 24	0 3 43	0 6 0	...	...	Struggled. Chloroformed fasting.
Do.	240	Full-grown, badly fed pariah.	4 5 0	0 0 46	0 1 58	0 3 8	0 6 23	...	...	Ditto ditto
Do.	241	Full-grown, well-nourished pariah.	4 13 6	0 2 3	0 2 23	0 3 8	0 5 0	...	...	Struggled very hard. Gaped after breathing had stopped. Chloroformed fasting.
Do.	242	Large-sized, full-grown, powerful pariah.	4 23 0	0 1 6	0 1 48	0 2 43	0 6 58	...	...	Had to be muzzled. Struggled very hard. Gaped after breathing stopped, and the pulse returned for 12 s. Chloroformed fasting.
Do.	243	Full-grown, healthy pariah.	4 34 50	0 1 3	0 2 23	0 3 12	0 8 5	...	...	Struggled feebly. Chloroformed fasting.
Do.	244	Full-grown, well-nourished pariah.	10 30 0	0 0 46	0 1 12	0 3 52	0 5 25	...	...	Dog struggled. Chloroformed fasting.
Do.	245	Ill-fed pariah, full grown.	10 37 55	0 0 38	0 1 22	0 2 33	0 4 53	...	...	Struggled hard. Gaped. Chloroformed fasting.
Do.	246	Thin, full-sized pariah dog, with healing sore on back.	10 43 10	0 0 56	0 1 14	0 3 37	0 6 0	...	...	Struggled. Chloroformed fasting.

1. (h).—Dogs chloroformed as they were obtained from the bazaar, and chloroformed with large doses on cloth inhaler.

Do.	247	Full-grown, badly nourished pariah.	10 50 50	0 0 55	0 2 3	0 5 48	0 6 36	...	...	Struggled hard. Gaped before heart stopped. Dog chloroformed as he was brought in.
Do.	248	Ditto.	11 0 0	0 0 48	0 1 36	0 2 45	0 4 58	...	...	Struggled.
Do.	249	Badly nourished (emaciated), full-grown pariah.	11 7 3	0 0 44	0 1 28	0 3 0	0 5 24	...	...	Struggled.
Do.	250	Well-nourished, full-grown pariah (very vicious).	11 17 30	0 0 50	0 1 47	0 6 33	0 7 48	...	...	Struggled very hard and gave trouble when being brought to the table. Gaped after breathing had stopped four times.
Do.	251	Full-sized, ill-fed pariah.	11 26 0	0 0 36	0 0 53	0 1 51	0 3 17	...	...	Struggled hard.
Oct. 29	252	Full-sized, well-fed, strong pariah.	11 32 40	0 1 22	0 2 31	0 4 16	0 11 12	...	...	Struggled. In this experiment the cessation of the heart's action was judged by means of a needle thrust into that organ, and not by auscultation as in the former cases.
Do.	253	Emaciated, full-grown pariah.	11 47 50	0 1 13	0 2 7	0 4 28	0 6 53	...	...	Struggled. Gaped several times. Needle used as in the last case.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornica became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1883. Oct. 29	254	Full-sized healthy pariah.	H. M. S. 3 1 11	H. M. S. 0 1 59	H. M. S. 0 2 42	H. M. S. 0 3 58	H. M. S. 0 12 8	H. M. S. ...	H. M. S. ...	Struggled hard.
Do.	255	Old pariah, blind of one eye from an opacity of cornea.	3 15 30	0 0 37	0 1 35	0 3 36	0 4 38	...	...	Struggled. Gaspd after breathing had ceased.
Do.	256	Full-grown, well-nourished pariah.	3 24 30	0 0 58	0 2 3	0 3 58	0 8 33	...	...	Struggled. Gaspd after breathing had ceased. Heart's action ceased to be heard with the stethoscope after 4 m. 37 s., but on thrusting a needle into the heart it was found to be acting and ceased only after 8 m. 33 s. from the time of inhalation.
Do.	257	Well-nourished, full-grown, powerful pariah.	3 40 45	0 0 56	0 2 4	0 4 52	0 6 30	...	...	Struggled.
Do.	258	Well-nourished, full-grown pariah.	3 56 10	0 0 48	0 1 16	0 3 17	0 6 40	...	...	Ditto.
Do.	259	Full-grown, well-nourished pariah.	4 4 0	0 0 53	0 1 50	0 2 43	0 7 38	...	...	Ditto.
Do.	260	Full-grown, ill-conditioned pariah.	4 16 25	0 1 36	0 2 37	0 3 35	0 6 33	...	...	Struggled very hard.
Oct. 30	261	Full-grown pariah fairly nourished.	10 1 0	0 1 10	0 2 1	0 2 45	0 5 30	...	...	Struggled and resisted as usual. Needle, with flag, thrust into the heart after stopping of pulse. Movements of flag, at first violent, gradually became feeble, and when they were reduced to mere vibration the heart was said to have ceased.

II. (a).—Two ounces of chloroform in tin box.

Do.	262	Ill-nourished, middle-sized pariah.	10 13 30	Not noted.	0 45 28	0 48 15	0 52 12	...	...	The anæsthetic was administered by placing the head and neck of the dog in a box 8 cubic feet in capacity, in which 2 oz. of chloroform had been evaporated. Dog struggled. Dog breathing naturally, with a good pulse, at 11 h. 10 m. Lid of box removed, and 2 oz. of chloroform placed in it on blotting-paper. Box covered again at 11 h. 10 m. 45 s. The first dose of chloroform in this experiment was placed in the box an hour previous to the inhalation, and it was proved afterwards that the lid had been removed more than once during this time.
Do.	263	Ill-nourished, under-sized pariah.	11 30 0	Do.	0 0 45	0 2 30	0 3 45	...	...	Box cleaned and dog chloroformed in the same way. Dog struggled. The inhalation was commenced immediately after the chloroform was put into the box.
Do.	264	Large-sized, full-grown pariah.	11 43 0	Do.	0 1 46	0 3 30	0 5 0	...	...	Dog struggled hard. Chloroformed in the same manner.
Do.	265	Ill-fed, small pariah.	3 0 0	Do.	0 2 43	0 6 8	0 6 55	...	...	Struggled as usual. Chloroformed as in the last case. Gaspd once before death.
Do.	266	Small-sized, full-grown, and weakly pariah.	3 16 50	Do.	0 1 37	0 2 51	0 4 29	...	...	Struggled as usual. Chloroform given as in the last case.

II. (b).—One ounce of chloroform instead of two ounces given in the tin box as in II. (a).

Do.	267	Full-sized, healthy, well-nourished pariah.	3 31 15	Not noted.	0 1 48	0 3 2	0 7 38	...	...	Dog struggled. One ounce of chloroform administered instead of two, but in the same tin box as in the last five cases.
Do.	268	Large-sized powerful pariah.	3 42 45	Do.	0 3 14	0 6 12	0 8 5	...	...	Struggled a great deal. Chloroform given as in Experiment 267.
Do.	269	Full-grown, ill-nourished pariah.	3 55 0	Do.	0 2 25	0 4 26	0 5 8	...	...	Struggled as usual. Chloroform given as in the last case.
Oct. 31	270	Full-grown, ill-nourished pariah.	9 48 0	Do.	0 2 30	0 6 30	0 7 42	...	...	Chloroformed in tin box as in the last case. Did not struggle at all during inhalation.
Do.	271	Full-grown, well-nourished pariah.	10 0 0	Do.	0 3 0	0 6 40	0 10 15	...	...	Struggled as usual. Breathed again 50 s. after the respiration ceased and continued breathing for 50 s. Chloroform given as in the last case.

II. (c).—Half an ounce of chloroform used in the tin box.

Do.	272	Fairly nourished, full-grown pariah.	10 14 10	Not noted.	0 7 25	0 13 55	0 16 10	...	...	Chloroformed as above. Struggled as usual, yelped loudly. Breathing returned 20 s. after it had stopped and continued for 5 m. 25 s. afterwards.
Do.	273	Full-grown, fairly well-nourished pariah.	10 35 20	Do.	0 19 4	0 19 4	0 19 12	...	...	Struggled very hard and yelped loudly. The breathing stopped very gradually in this case, becoming shallow by degrees until it ceased. Chloroformed as in the last case.

Date.	No	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889 Oct. 31	274	Large-sized powerful, full-grown pariah.	11 2 0	Not noted.	...	...	...	...	...	Struggled and yelped loudly. Breathing became stertorous after 19 m. 15 s. Convulsions set in at 11.45 o'clock. The dog gradually recovered and was let loose at 12.15.
Do.	275	Full-grown, healthy pariah.	3 38 0	Do.	0 11 15	0 12 2	0 13 12	...	...	Struggled and yelped loudly. Breathing stopped very gradually as in Experiment 273. The action of the heart became very intermittent towards the end. There were three distinct intervals of about 8 s. each, when there were no contractions, each interval being followed by very quick cardiac action. Chloroform given as in the last case.
Do.	276	Powerful, full-grown, healthy pariah.	4 6 0	Do.	0 17 5	0 17 12	0 18 2	...	...	Had to be muzzled. Struggled a great deal. Breathing ceased very gradually. Chloroformed as in the last case.

I. (i).—*Dogs chloroformed with about two ounces of chloroform at a time on a cloth inhaler.*

Do.	277	Full-grown, healthy pariah.	11 48 0	0 0 55	0 1 17	0 2 5	0 4 3	...	...	Struggled as usual.
Do.	278	Ditto.	11 55 0	0 0 1 7	0 1 58	0 3 21	0 5 34	...	...	Struggled as usual.
Do.	279	Full-grown, pariah pup.	3 43 0	0 0 45	0 1 23	0 1 52	0 4 28	...	...	Held its breath a great deal, and then made some very full inspirations. Gapsed before heart stopped. The dog struggled as usual.
Do.	280	Full-grown, healthy pariah.	3 55 55	0 0 1 18	0 2 11	0 4 28	0 6 18	...	...
Do.	281	Large-sized, full-grown pariah.	4 13 45	0 0 1 10	0 3 5	0 3 12	0 8 42	...	...	Struggled in the usual manner.

II. (a).—*Two ounces of chloroform given in tin box*

Nov. 1	282	Under-sized, ill-fed pariah.	9 49 0	Not noted.	0 4 30	0 6 0	0 7 24	...	...	Chloroformed in tin box. Struggled as usual. Temperature in rectum at 9 h. 53 m. during inhalation 101° F. Temperature same after heart stopped.
Do.	283	Full-grown, well-nourished pariah.	10 2 30	Do.	0 11 47	0 12 30	0 15 17	...	...	Did not struggle at all. Temperature in rectum at 10 h. 5 m. 30 s. during inhalation 100° F. Temperature when heart stopped, 100° 5' F.
Do.	284	Under-sized, ill-nourished pariah.	10 26 30	Do.	0 4 40	0 5 25	0 5 30	...	...	Chloroformed as above. Struggled as usual. Temperature in rectum before inhalation 102° 4' F., when heart stopped 103° F.
Do.	285	Full-sized, well-nourished pariah.	10 41 50	Do.	0 4 46	0 5 52	0 9 38	...	...	Temperature before inhalation 99° 8' F. Struggled. Temperature immediately after death 100° 4' F.
Do.	286	Full-sized, pariah, with opacity of cornea in one eye.	10 58 13	Do.	0 4 24	0 5 8	0 8 59	...	...	Temperature (a) before inhalation 102° F.; (b) after heart stopped 102° 8' F. Struggled.

II (b).—*One ounce of Chloroform given in tin box*

Do.	287	Full-sized, well-nourished pariah.	11 12 0	Not noted.	0 8 31	0 10 0	0 14 6	...	...	Struggled very hard. Temperature before inhalation 102° F.; after heart ceased 103° F.
Do.	288	Full-sized, healthy pariah.	11 32 0	Do.	0 6 17	0 7 12	0 10 4	...	...	Temperature before inhalation 103° 8' F.; after heart ceased 104° F. Struggled as usual.
Do.	289	Emaciated, full-grown pariah, lame in one leg from an old fracture.	3 7 0	Do.	0 4 12	0 4 53	0 10 13	...	...	Dog struggled. Temperature before inhalation 101° 6' F.; after death 101° 8' F. Gapsed before the heart ceased. Pulse returned and lasted for 1 m. 50 s.
Do.	290	Full-grown, healthy pariah.	3 25 30	Do.	0 4 3	0 6 47	0 8 42	...	...	Temperature before inhalation 103° F. Dog struggled. After death 103° 4' F.
Do.	291	Ill-nourished full-grown pariah.	3 40 30	Do.	0 7 26	0 8 33	0 11 53	...	...	Temperature before inhalation 103° F. Dog struggled. Breathing stopped very gradually. Temperature after death 104° F.

II. (c).—*Half an ounce of chloroform used in these cases in tin box*

Do.	292	Full-grown, ill-nourished pariah.	3 58 15	Not noted.	0 8 11	0 9 38	0 10 28	...	...	Dog struggled. Temperature before inhalation 103° F.; after death 103° 2' F.
Nov. 2.	293	Under-sized, ill-nourished pariah.	9 26 0	Do.	0 10 40	0 11 10	0 15 40	...	...	Struggled as usual. Temperature in rectum before inhalation 99° 8' F. Temperature remained the same when heart ceased acting. Gapsed at 9 h. 38 m.
Do.	294	Under-sized, fairly well nourished pariah.	9 47 12	Do.	0 16 0	0 17 25	0 19 55	...	...	Struggled as usual. Temperature in rectum before inhalation 100° F., and remained the same when heart ceased acting.
Do.	295	Under-sized, fairly nourished pariah.	10 29 0	Do.	0 10 30	...	...	...	...	Chloroformed as above. Temperature in rectum before inhalation 102° F. Respiration, after stopping for 30 s., returned again, and the dog gradually recovered. Temperature when removed 102° 6' F. Removed from the box at 11 o'clock.
Do.	296	Full-grown, lean pariah.	11 7 45	Do.	0 14 8	0 16 31	0 18 1	...	...	Temperature in rectum before inhalation 100° 6' F., after death 101° F. Struggled a great deal.

III. (a).—*In these cases one-fourth of a grain of morphine hydrochloras was injected over the epigastrium of the dog fifteen minutes before the inhalation. Chloroform in large doses given on the cloth inhaler.*

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks
1889. Nov. 2.	297	Full-grown, small-sized pariah.	H. M. S. 11 14 30	H. M. S. 0 1 3	H. M. S. 0 1 45	H. M. S. 0 2 7	H. M. S. 0 6 33	H. M. S. ...	H. M. S. ...	Morphine injected at 10 h. 59 m. Struggled as usual.
Do.	298	Full-grown well-nourished pariah.	11 30 0	0 1 38	0 3 12	0 3 37	0 6 22	...	...	Morphine injected at 11 h. 16 m. Dog struggled.
Do.	299	Full-grown, healthy pariah.	11 46 0	0 1 48	0 2 5	0 3 13	0 7 58	...	...	Morphine injected at 11 h. 32 m. Struggled. Gapsed after pulse stopped.
Do.	300	Full-sized, well-nourished pariah puppy.	2 36 0	0 0 35	0 1 5	0 1 10	0 2 5	...	...	Morphine injected at 2 h. 22 m. Pulse ceased almost immediately after the respiration stopped. Struggled.
Do.	301	Full-sized, well-nourished pariah.	2 45 0	0 0 43	0 1 33	0 1 52	0 5 3	...	...	Morphine injected at 2 h. 30 s. Gapsed after pulse stopped.

III. (b).—*Half grain of morphine injected in these dogs before being chloroformed with large doses on the cloth cap inhaler.*

Do.	302	Full-sized, ill-nourished pariah.	3 3 10	0 1 1	0 2 12	0 3 4	0 5 17	...	...	Morphine injected at 2 h. 48 m. Dog struggled.
Do.	303	Large-sized, well-nourished pariah.	3 16 2	0 0 44	0 2 8	0 3 36	0 4 53	...	...	Morphine injected at 3 p.m. Struggled very hard and got loose. Caught and brought back, and held down forcibly a second time.
Do.	304	Full-sized, healthy pariah.	3 25 10	0 1 10	0 2 29	0 4 42	0 5 2	...	...	Morphine injected at 3 h. 11 m. 20 s. Gapsed after pulse stopped.
Do.	305	Full-sized, ill-nourished pariah with a cyst on tongue.	3 38 20	0 1 3	0 1 36	0 2 28	0 5 47	...	...	Morphine injected at 3 h. 23 m.
Nov. 4	306	Full-sized, fairly nourished pariah.	9 30 0	0 0 45	0 1 20	0 1 50	0 5 8	...	...	Morphine at 9 h. 15 m. Struggled as usual. Pulse stopped 30 s. after respiration

V. (d).—*Artificial respiration tried after respiration ceased on dogs that had had a subcutaneous injection of half a grain of morphine. (The chloroform was given in large doses on the cloth cap inhaler.)*

Do.	307	Under-sized, fairly nourished pariah.	9 55 0	0 0 40	0 1 40	0 4 0	Not noted.	9 56 50	0 4 0	Morphine injected at 9 h. 33 m. Pulse found to have stopped at 4 m. after inhalation began. Artificial respiration commenced 10 s. after respiration ceased; continued for 4 m. Flag introduced into heart at the end of 4 m. did not vibrate. Artificial respiration commenced 10 s. after breathing stopped. Unsuccessful.
Do.	308	Ill-nourished, mangy pariah puppy, between four and five months old.	10 7 0	0 0 45	0 1 40	0 4 50	0 5 25	10 9 0	0 4 0	Morphine injected at 9 h. 47 m. Struggled slightly. Artificial respiration continued for 4 m.; no effect. Pulse stopped during artificial respiration. Artificial respiration commenced after 20 s. Unsuccessful.
Do.	309	Full-grown, pariah puppy, emaciated.	10 28 50	0 0 46	0 1 4	Not noted.	Not noted.	10 30 15	0 6 0	Morphine injected at 10 h. 17 m. Dog died. Artificial respiration commenced after 20 s. Unsuccessful.
Do.	310	Full-grown, powerful pariah.	10 38 0	0 0 48	0 1 52	...	...	10 40 0	0 8 0	Morphine injected at 10 h. 23 m. Natural respiration re-established at 10 h. 48 s. Artificial respiration commenced 8 s. after breathing stopped. Successful.
Do.	311	Emaciated, full-sized pariah.	11 6 0	0 1 0	0 3 4	Not noted.	Not noted.	11 9 20	0 12 0	Half grain morphine injected at 10 h. 52 m. Artificial respiration commenced 16 s. after breathing stopped. Unsuccessful.

III. (e).—*Half a grain of morphine injected fifteen minutes before, and varying quantities of strychnine immediately before administration of chloroform. Artificial respiration tried.*

Chloroform given in large doses in cloth cap inhaler.

Nov. 5.	312	Ill-nourished, under-sized pariah.	9 48 0	0 1 0	0 2 30	0 5 0	0 7 10	...	...	Morphine injected at 9 h. 33 m.; .02 gr. strychnine injected immediately before inhalation.
Do.	313	Badly nourished, under-sized pariah.	10 0 0	0 1 4	0 2 0	0 2 30	0 4 15	...	...	Morphine injected at 9 h. 45 m.; and .02 gr. of strychnine immediately before inhalation.
Do.	314	Fairly nourished, small-sized pariah.	10 22 0	0 0 45	0 1 30	0 1 53	0 8 3	...	...	Morphine injected at 10 h. 7 m.; .02 gr. of strychnine injected at 10 h. 22 m.
Do.	315	Full-sized, well-nourished pariah.	10 45 0	0 0 40	0 2 10	0 3 3	0 9 13	...	...	Morphine injected at 10 h. 30 m.; strychnine (.02 gr.) injected at 10 h. 44 m.
Do.	316	Full-grown, well-nourished pariah.	10 54 0	0 0 46	0 1 23	0 2 28	0 6 8	...	...	Morphine injected at 10 h. 35 m.; strychnine (.02 gr.) injected at 10 h. 53 m.
Do.	317	Full-grown, small-sized pariah.	11 0 30	0 0 53	0 2 8	0 2 53	0 6 41	...	...	Morphine injected at 10 h. 44 m.; strychnine (.02 gr.) injected at 11 h.
Do.	318	Full-grown, ill-nourished pariah.	11 8 0	0 0 42	0 1 7	0 2 40	0 6 1	...	...	Morphine injected at 10 h. 52 m.; strychnine (.03 gr.) at 11 h. 7 m. 30 s.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889.										
Nov. 5.	319	Full-grown, healthy pariah.	11 16 30	0 59 0	0 2 1	0 2 32	0 6 30	...	...	Morphine injected at 11 h. 2 m.; strychnine (.03 gr.) injected at 11 h. 16 m.
Do.	320	Full-grown, healthy pariah.	11 25 12	0 1 0	0 3 30	0 4 11	0 9 33	...	...	Morphine injected at 11 h. 8 m.; strychnine (.03 gr.) injected at 11 h. 25 m.
Do.	321	Full-grown, healthy pariah.	11 36 30	0 1 20	0 3 46	0 4 15	0 9 50	...	...	Morphine injected at 11 h. 16 m.; strychnine (.03 gr.) injected at 11 h. 35 m. 50 s.
Do.	322	Full-grown, powerful pariah.	11 47 0	0 0 54	0 13 4	0 13 46	0 14 6	...	...	Morphine injected at 11 h. 21 m.; strychnine (.03 gr.) injected at 11 h. 46 m. The respiration ceased for 40 s. at 11 h. 52 m. and returned.
Do.	323	Full-grown, healthy pariah.	12 6 0	0 1 15	0 2 0	0 2 54	0 4 50	...	...	Morphine injected at 11 h. 29 m.; strychnine (.03 gr.) injected at 12 h. 5 m.
Do.	324	Full-grown, large-sized, healthy pariah.	12 13 30	0 1 2	0 2 28	0 3 0	0 5 26	...	...	Morphine injected at 11 h. 56 m.; strychnine (.03 gr.) injected at 12 h. 13 m.
Do.	325	Full-grown, large-sized, ill-nourished pariah.	2 59 0	0 0 45	0 1 15	0 2 10	0 3 40	...	...	Morphine injected at 2 h. 44 m.; strychnine (.03 gr.) injected at 2 h. 58 m. Began to gasp 15 s. after respiration ceased.
Do.	326	Under-sized, ill-nourished pariah.	3 4 0	0 0 45	0 2 25	0 2 30	0 6 40	...	...	Morphine injected at 2 h. 47 m.; strychnine (1-10th gr.) injected at 3 h. 4 m. 15 s. Gaped five times 25 s. after cessation of respiration.

III. (d).—Half a grain of morphine injected fifteen minutes before the experiment, and varying quantities of atropine immediately before. The chloroform was given in large doses on cloth inhaler.

Do.	327	Full-grown, healthy pariah.	3 12 30	0 1 10	0 1 55	0 2 23	0 5 55	...	...	Morphine injected at 2 h. 50 m.; atropine (1-100th gr.) injected at 3 h. 12 m.
Do.	328	Ditto.	3 22 0	0 1 12	0 2 8	0 2 15	0 7 35	...	...	Morphine injected at 2 h. 55 m.; atropine (1-50th gr.) injected at 3 h. 21 m. 30 s.
Do.	329	Small-sized, healthy pariah.	3 33 30	0 0 58	0 3 7	0 3 14	0 5 35	...	...	Morphine injected at 3 h. 10 m.; atropine (3-100ths gr.) injected at 3 h. 32 m.
Do.	330	Small, healthy pariah.	3 41 10	0 0 50	0 4 48	0 5 6	0 8 2	...	...	Morphine injected at 3 h. 20 m.; atropine (1-25th gr.) injected at 3 h. 40 m.
Do.	331	Full-sized, well-nourished pariah.	3 52 0	0 1 22	0 2 18	0 2 54	0 6 35	...	...	Morphine injected at 3 h. 35 m.; atropine (1-20th gr.) injected at 3 h. 51 m.
Do.	332	Ditto.	4 0 45	0 1 12	0 5 53	0 6 55	0 7 52	...	...	Morphine injected at 3 h. 46 m.; atropine (3-50ths gr.) injected at 3 h. 59 m.
Do.	333	Ditto.	4 18 0	0 0 37	0 2 36	0 3 24	0 5 15	...	...	Morphine injected at 3 h. 55 m.; atropine (7-100ths gr.) injected at 4 h. 17 m.
Do.	334	Full-grown, healthy pariah.	4 24 30	0 0 50	0 2 3	0 2 41	0 5 8	...	...	Morphine injected at 4 h. 5 m.; atropine (8-100ths gr.) injected at 4 h. 23 m.
Nov. 6.	335	Under-sized, ill-nourished pariah.	10 8 0	0 1 20	0 2 25	0 2 30	0 5 5	...	...	Morphine injected at 9 h. 45 m.; atropine (9-100ths gr.) injected at 10 h. 7 m. Found to be quite narcotised from effect of morphine.
Do.	336	Ditto.	10 16 0	0 1 8	0 2 0	0 2 28	0 4 50	...	...	Morphine injected at 9 h. 55 m.; atropine (1-10th gr.) injected at 10 h. 15 m.

III. (e).—Half a grain of morphine injected some minutes before the experiment and varying quantities of atropine and strychnine immediately before. The chloroform was administered in large doses in cloth cap inhaler.

Do.	337	Full-grown, fairly well-nourished pariah.	10 41 0	0 0 55	0 1 30	0 2 42	0 4 0	...	...	Morphine injected at 10 h. 23 m. Atropine (1-100th gr.) and strychnine (1-100th gr.) injected at 10 h. 19 m. 45 s. Chloroformed with the cloth cap inhaler as in previous cases.
Do.	338	Full-grown, under-sized, fairly well-nourished pariah.	10 47 50	0 0 58	0 2 2	0 5 42	0 7 56	...	...	Morphine injected at 10 h. 33 m. Atropine (1-50th gr.) and strychnine (1-50th gr.) of each injected at 10 h. 47 m.
Do.	339	Full-grown large-sized pariah.	11 0 0	0 1 33	0 2 10	0 2 52	0 4 13	...	...	Morphine injected at 10 h. 45 m. 30 s. Injected strychnine (3-100ths gr.) and atropine (3-100ths gr.) at 10 h. 59 m.
Do.	340	Full-grown, healthy pariah.	11 9 10	0 0 53	0 2 35	0 3 2	0 4 20	...	...	Morphine injected at 10 h. 55 m. Injected strychnine (1-25th gr.) and atropine (1-25th gr.) at 11 h. 7 m.
Do.	341	Full-grown, well-nourished pariah.	11 28 5	0 1 28	0 2 5	0 3 3	0 6 15	...	...	Morphine injected at 11 h. 10 m. Atropine (1-20th gr.) and strychnine (1-20th gr.) injected at 11 h. 27 m.
Do.	342	Full-grown, emaciated pariah.	11 40 0	0 0 59	0 1 30	0 2 3	0 4 0	...	...	Morphine injected at 11 h. 21 m. Atropine (6-100ths gr.) and strychnine (6-100ths gr.) injected at 11 h. 39 m.
Do.	343	Large-sized, full-grown pariah.	12 14 0	0 2 4	0 6 11	0 8 30	0 14 13	...	...	Morphine ($\frac{1}{2}$ gr.) injected at 11 h. 50 m. Strychnine (7-100ths gr.) and atropine (7-100ths gr.) injected at 12 h. 5 m. Chloroformed in a box, as it attempted to bite everyone that approached it. Lid of box removed and chloroform given in the usual way at 12 h. 16 m. 15 s.
Do.	344	Full-grown, ill-nourished pariah.	3 36 40	0 0 53	0 1 22	0 1 55	0 5 53	...	...	Morphine injected at 3 h. 20 m. Atropine (8-100ths gr.) and strychnine (8-100ths gr.) injected at 3 h. 36 m.
Do.	345	Ditto.	3 45 0	0 1 8	0 1 46	0 2 12	0 8 12	...	...	Morphine injected at 3 h. 25 m. Atropine (9-100ths gr.) and strychnine (9-100ths gr.) injected at 3 h. 44 m.

Date.	No	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Nov. 6	346	Full-grown, ill-nourished pariah.	3 55 0	0 1 6	0 1 48	0 2 0	0 5 6	...	...	Morphine injected at 3 h. 37 m. Atropine (1-10th gr.) and strychnine (1-10th gr.) injected at 3 h. 54 m.
Do.	347	Small-sized, healthy pariah.	4 15 45	0 1 4	0 2 1	0 2 48	0 6 3	...	...	Morphine injected at 4 h. 5 m. Atropine and strychnine (aa 1-10th gr.) injected at 4 h. 11 m.
Do.	348	Full-grown pariah puppy.	4 21 0	0 1 13	0 1 24	0 2 0	0 4 53	...	...	Morphine injected at 4 h. 6 m. Atropine and strychnine (aa 1-10th gr.) injected at 4 h. 19 m. 30 s.
IV. (a).—Chloroform administered in a special bottle and inhaler with valves attached. (Vide Appendix B.)										
Nov. 7.	349	Small-sized, badly-fed pariah.	10 47 0	0 10 0	...	...	...	...	...	This was a trial experiment to see if the valves in the apparatus worked properly. The dog was allowed to revive, as several interruptions occurred.
Do.	350	Full-sized, healthy pariah.	11 12 30	0 6 43	...	...	...	...	...	Half an ounce of chloroform given in an apparatus specially devised for the purpose. By this means air was allowed to mix freely with the chloroform vapour in a bottle connected with the inhaler. Breathing became very rapid after the lapse of 14 m. (62 to the minute); after 25 m. it became very shallow, and remained so for half an hour. The cornea remained insensitive for fully an hour and a half. The dog gradually recovered, and was removed from the table at 10 m. past 1 P.M.
Nov. 8.	351	Full-grown, small-sized pariah.	10 4 0	0 0 27	0 44 45	0 45 5	0 47 10	...	...	Half an ounce of chloroform given as in the above case. After 20 m. the tube, connected with the inhaler, for the exit of the expired air, was removed, as the valves were acting imperfectly, and the aperture of the tube was closed with a cork, to which a new valve was attached. Breathing became very slow and shallow towards death. This observation was not considered trustworthy on account of the interruptions during the experiment.
Do.	352	Small-sized, ill-fed pariah.	10 37 17	Not noted.	0 7 3	0 10 14	0 10 34	...	...	This observation is reliable, as the valves in the tubes were acting perfectly, and no interruption occurred; $\frac{1}{2}$ oz. of chloroform was given as in the above case.
Do.	353	Full-grown, ill-nourished puppy.	11 14 30	0 1 48	0 18 8	0 19 1	0 22 14	...	...	Half an ounce of chloroform given as in the last case.
Do.	354	Small-sized, ill-fed pariah.	2 48 0	0 1 50	0 5 0	0 7 0	0 9 30	...	...	Ditto.
IV. (b).—Three drachms of chloroform given in the same bottle apparatus.										
Do.	355	Small-sized, ill-nourished pariah.	3 1 15	0 1 15	1 16 10	1 17 18	1 20 25	...	...	Three drachms of chloroform given in this case. The respiration became slow and laboured at 3 h. 15 m., and remained so for 45 m.; but as there were no indications of the dog dying at this time, an extra drachm of chloroform was poured into the bottle at 4 h. 3 m.
Do.	356	Ditto.	4 28 10	0 1 45	0 10 35	0 11 6	0 14 40	...	...	3 drs. of chloroform given as in the last case. After the breathing had stopped after 10 m. 35 s., it recovered in a minute's time and continued for 1 m. and 8 s., when it stopped again.
IV. (c).—Two drachms of chloroform given in the same bottle apparatus.										
Do.	357	Small-sized, ill-nourished pariah.	4 45 50	0 1 3	...	...	...	...	...	3 drs. of chloroform given in the same apparatus as in the last case. An extra drachm was poured into the bottle at 5 m. 20 s. Was seen to be recovering at 5 m. 49 s., and an extra drachm of chloroform was again placed in the bottle. At 6 m. 10 s. the dog was found to be again reviving, and he was removed from the table.
Nov. 9.	358	Ditto.	9 48 20	0 2 20	0 20 10	0 23 30	0 25 10	...	...	2 drs. of chloroform given as above, and had to be repeated, as the dog was recovering at 10 h. 8 m.
Do.	359	Full-sized, well-nourished pariah.	10 18 6	0 1 30	2 7 30	2 8 40	2 9 2	...	...	2 drs. of chloroform given as above. Dog was recovering at 11 h. 9 m. 1 dr. of chloroform added at 11 h. 10 m. Dog was seen to be recovering again at 12, when another drachm of chloroform was added. Dog 27 lb. in weight.
I. (f).—Five dogs fed with gruel at 12 30 o'clock and chloroform in the usual way with large doses on a cloth inhaler.										
Do.	360	Full-grown, healthy pariah	2 30 5	0 1 8	0 2 35	0 3 23	0 5 2	...	...	Struggled as usual. Weight of dog 24 lb.
Do.	361	Ditto.	2 41 20	0 1 2	0 1 53	0 3 47	0 5 11	...	...	Struggled more than usual. Dog weighed 26 lb.
Do.	362	Ditto.	2 52 18	0 1 33	0 2 55	0 3 29	0 5 16	...	...	Struggled as usual. Dog's weight 32 lb.
Do.	363	Ditto.	3 6 0	0 2 3	0 3 20	0 4 5	0 5 42	...	...	Do. Do. 28 lb.
Do.	364	Ditto.	3 15 30	0 0 42	0 1 53	0 3 55	0 5 6	...	...	Do. Do. 25 lb.

IV. (c) — *Two drachms of chloroform given in bottle apparatus.*

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Nov. 11.	365	Full-grown well-fed pariah.	H. M. S. 9 20 0	H. M. S. 0 1 10	H. M. S. 0 2 40	H. M. S. 2 46 30	H. M. S. 2 53 0	H. M. S. ...	H. M. S. ...	2 drs. of chloroform given in the bottle apparatus, 1 dr. repeated at 10 h. 27 m., and again at 11 and again at 11 h. 40 m.

I. (f) — *Five dogs fed with gruel at 9 a m., and chloroformed with large doses on a cloth inhaler in the usual manner.*

Do.	366	Full-grown, large-sized powerful pariah.	10 36 30	0 0 45	0 1 10	0 1 48	0 5 24	...	...	Struggled as usual. Weight of dog 32 lb
Do.	367	Full-grown large-sized pariah.	10 46 30	0 0 54	0 1 38	0 2 5	0 4 40	...	...	Do. Do. 40 lb.
Do.	368	Full-grown, healthy and large-sized pariah.	10 49 0	0 1 5	0 1 14	0 2 48	0 6 2	...	...	Do. Do. 34 lb.
Do.	269	Full-grown, healthy, large-sized pariah.	11 4 55	0 0 52	0 2 12	0 2 35	0 5 43	...	...	Struggled more than usual. Weight of dog 32 lb.
Do.	370	Full-grown, strong pariah	11 14 30	0 1 17	0 2 23	0 11 33	0 13 18	...	...	Struggled as usual. In this case the respiration, after ceasing for 4 m., during which period the pulse could be distinctly felt, returned again and lasted for 3½ minutes. Weight of dog 36 lb.

V. (a). — *Artificial respiration practised in these cases the chloroform being given in large doses on the cloth cap inhaler.*

Do.	371	Small-sized, full-grown pariah.	11 39 30	0 1 10	0 2 40	Had not stopped.	...	11 42 50	0 5 0	Artificial respiration commenced 40 s. after respiration had ceased. The dog was thought to be breathing naturally after one minute and was left alone, when the breathing ceased again and could not be re-established. Weight of dog 19 lb.
Do.	372	Do.	11 53 48	0 0 55	0 2 4	Do.	...	11 55 59	0 2 0	Artificial respiration was commenced 10 s. after respiration had ceased. The dog recovered. Weight of dog 23 lb.

I. (b.) — *Monkey chloroformed in glass box (vide Appendix B).*

Do.	373	Small monkey.	1 58 33	...	...	...	...	...	...	2 drs. of chloroform into a one-foot cube glass case containing monkey; not air tight; fell down after 2 m. 15 s.; taken out after 9 m. 50 s. and chloroform pushed on cloth cap inhaler. Cornea sensitive; great salivation; lay on his side and grabbed at imaginary objects until 2 h. 12 m. 30 s., when he jumped off the table.
Do.	374	Same.	2 12 55	...	0 3 40	Shortly after respiration.	0 5 58	...	...	Chloroformed in glass box and then taken out and the anæsthetic pushed on cloth cap inhaler. Monkey 4½ lb. in weight.
Do.	375	Small monkey.	2 21 30	0 1 30	0 2 0	0 2 10	0 9 30	...	...	Chloroformed in the same way as before. Weight of monkey 5 lb.
Do.	376	Ditto.	2 34 0	...	0 9 30	0 10 5	0 16 15	...	...	In glass box at 2 h. 34 m. Fell down at 2 h. 35 m. 30 s. Taken out of box at 2 h. 38 m. 30 s. Cornea sensitive, but became insensible 30 s. after removal from box and administering more chloroform. Heart ceased 6 m. 10 s. after respiration stopped. Weight 4 lb.
Do.	377	Ditto.	3 0 0	0 5 0	0 5 30	0 6 10	0 14 45	...	...	In glass box at 3 h. and chloroformed. Fell down at 3 h. 4 m. Taken out of box at 3 h. 4 m. 30 s., and more chloroform given. Heart ceased 9 m. 15 s. after respiration stopped. Weight 5 lb.
Do.	378	Ditto.	3 13 0	0 7 36	0 14 20	0 15 55	0 17 23	...	...	In glass box at 3 h. 13 m. and chloroformed. Fell down at 3 h. 20 m. Taken out of box at 3 h. 20 m. 30 s. Weight 5 lb.
Do.	379	Ditto.	3 35 0	0 0 32	0 0 50	0 1 20	0 3 21	...	...	This monkey was asphyxiated when brought on the table owing to the noose around his neck having been drawn too tightly, and he was, after much difficulty, recovered. He was immediately after chloroformed on the table and not placed in the box. Weight of monkey 6 lb.
Do.	380	Ditto.	3 43 13	0 3 4	9 7 32	0 8 12	0 9 3	...	...	Put into the glass box at 3 h. 42 m. 13 s. Fell down at 3 h. 45 s. Taken out of box at 3 h. 45 m. 30 s. Chloroform pushed as in the other cases.
Nov. 12.	381	Young monkey	10 23 0	0 8 30	0 11 30	0 12 50	0 14 15	...	...	Put into the glass box at 10 h. 23 m. Fell down at 10 h. 30 m., taken out of box at 10 h. 32 m. Temperature after taking him out of box 101·4° F.; temperature after death 100·4° F. Weight 5 lb.
Do.	382	Ditto.	10 54 0	0 16 12	0 17 3	0 16 7	0 28 5	...	...	Put into the glass box at 10 h. 54 m. Fell down at 11 h. 7 m. 30 s. Taken out of box at 11 h. 9 m. 4 s., and cloth inhaler placed over head. Temperature 103·2° F. when taken out of the glass box; after death 102·3° F. Weight 4 lb.

1 (J).—Five dogs chloroformed with large doses in cloth inhaler after the administration of a large quantity of coffee.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Nov. 12.	383	Full-grown, small pariah.	H. M. S. 11 42 0	H. M. S. 0 0 45	H. M. S. 0 1 42	H. M. S. 0 2 52	H. M. S. 0 4 15	H. M. S. ...	H. M. S. ...	Temperature before inhalation 102° F. After death 103·2° F. Drank 12 oz. of prepared coffee at 11 o'clock. Weight 16 lb.
Do.	384	Ditto.	11 53 0	0 0 39	0 1 37	0 2 8	0 5 45	...	...	Temperature before inhalation 104° F. Had 12 oz. of prepared coffee at 11. Temperature after death 104° F. Weight 18 lb.
Do.	385	Full-sized badly nourished pariah.	2 30 30	0 1 10	0 1 45	0 5 5	0 7 15	...	...	Temperature before inhalation 100° F. Temperature after death 100·6° F. Had about 12 oz. of coffee about 2 min. before inhalation. Weight 24 lb.
Do.	386	Under-sized, fairly nourished pariah.	2 43 0	0 1 15	0 2 30	0 3 50	0 6 35	...	...	Temperature before inhalation 102·8° F. Temperature after death 102·8° F. Had about 12 oz. of coffee half an hour before inhalation. Weight 16 lb.
Do.	387	Under-sized, badly nourished pariah.	2 55 30	0 1 30	0 2 10	0 3 45	0 4 0	...	...	Temperature before inhalation 102·5° F. Temperature after death 102·5° F. Had 12 oz. of coffee three quarters of an hour before inhalation. Weight 19 lb.
V. (a).—Artificial respiration tried in three cases, the chloroform being administered in large doses on cloth inhaler.										
Do.	388	Full-grown, large-sized, pariah.	3 7 0	0 0 43	0 3 55	...	...	3 11 5	0 3 0	Struggled a great deal. Artificial respiration commenced 10 s. after respiration had ceased. Dog revived after artificial respiration had been practised for 2 m. Weight 25 lb.
Do.	389	Old, large-sized pariah.	3 20 0	0 0 52	0 4 30	...	...	3 24 50	0 3 0	Artificial respiration commenced 20 s. after respiration had ceased. The dog gasped twice, but could not be revived. Weight of dog 32 lb.
Nov. 13.	390	Full-grown, small, and badly nourished pariah.	10 48 0	0 0 46	0 1 30	...	...	10 49 50	0 3 0	Artificial respiration was commenced 20 s. after breathing had ceased. Dog revived.
Do.	391	Full-grown, small-sized, badly nourished pariah.	10 57 0	0 2 10	0 6 40	...	...	11 4 10	0 1 30	Artificial respiration was commenced 30 s. after breathing had ceased. Dog revived.
Do.	392	Full-grown, well-nourished, pariah.	11 9 0	0 0 52	0 5 12	...	...	11 14 47	0 6 0	Artificial respiration was commenced 35 s. after breathing had ceased, and proved unsuccessful.
Do.	393	Old, small, and emaciated pariah.	11 31 0	0 1 10	0 2 25	...	...	11 34 0	0 4 0	Artificial respiration was commenced 35 s. after breathing had ceased, and proved unsuccessful.
Do.	394	Under-sized, fairly nourished pariah.	2 40 0	0 0 45	0 1 30	...	...	2 42 0	0 6 0	Artificial respiration commenced 30 s. after respiration stopped. Gasped twice after 2 m., and ceased. Artificial respiration started again, and continued for 4 m., and proved unsuccessful.
Do.	395	Full-sized, well-nourished pariah.	2 50 0	0 0 55	0 2 5	...	...	2 52 20	0 9 0	Artificial respiration commenced 15 s. after respiration ceased, and continued for 9 m.; proved unsuccessful.
Do.	396	Ditto.	3 3 0	0 0 30	0 1 30	...	...	3 4 35	0 3 0	Artificial respiration was commenced 5 s. after the respiration had ceased. Dog revived.
Do.	397	Full-sized, healthy pariah.	3 12 45	0 1 12	0 2 35	...	...	3 15 50	0 4 0	Artificial respiration commenced 30 s. after the respiration had ceased, and proved unsuccessful.
Do.	398	Ditto.	3 27 30	0 1 17	0 2 45	...	...	3 30 50	0 1 0	Artificial respiration was commenced 35 s. after the respiration had ceased. Dog revived.
Do.	399	Small, but full-grown pariah	3 44 30	0 2 0	0 1 30	...	...	3 46 30	0 6 0	Artificial respiration was commenced 30 s. after the respiration had ceased; unsuccessful.
Nov. 14.	400	Full grown, small, ill-nourished, pariah.	10 26 0	0 0 7	0 8 8	Not noted.	...	10 35 8	0 6 0	Chloroformed in a deal wood box 8 cubic feet capacity. Dog fell down at 10 h. 32 m. 32 s.; taken out at 3 h. 33 m. and placed on the table and some chloroform given. Artificial respiration was commenced 1 m. after breathing had ceased. A needle was put into the heart at 10 h. 41 m., and the heart was found to be contracting. Artificial respiration continued for 6 m., but proved unsuccessful.
Do.	401	Large-sized, ill-nourished pariah.	10 53 0	Not noted.	0 12 0	Not noted.	...	11 6 0	0 6 0	Chloroformed in the same manner at 10 h. 53 m. Dog fell down at 10 h. 57 m. 30 s. Taken out at 10 h. 58 m. and placed on the table and more chloroform given. Artificial respiration was commenced 1 m. after the respiration ceased. It was continued for 6 m., but proved unsuccessful.
Do.	402	Large-sized well-nourished pariah.	11 15 0	...	0 16 10	...	...	11 31 35	0 2 0	Chloroformed in the same manner at 11 h. 15 m. Dog fell down at 11 h. 23 m. 45 s. Taken out at 11 h. 26 m. 30 s., placed on table, and more chloroform given. Artificial respiration was commenced 25 s. after the breathing had ceased, and proved successful.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Nov. 14.	403	Large-sized, well-nourished pariah.	11 36 0	...	0 9 2	...	...	11 45 32	0 8 0	Chloroformed in the same way. Fell down at 11 h. 39 m. 36 s. Taken out and chloroformed on table at 11 h. 40 m. Artificial respiration was commenced 30 s. after the breathing had ceased, and proved to be unsuccessful.
Do.	404	Full-sized, ill-nourished pariah.	11 53 10	0 3 30	0 6 8	...	...	11 59 43	0 4 0	Chloroformed in the same way. Dog fell down at 11 h. 55 m. 28 s. Taken out at 11 h. 56 s., placed on the table, and chloroformed again. Artificial respiration was commenced 25 s. after the respiration had ceased, and proved unsuccessful.
Do.	405	Full-sized, well-nourished pariah, and one that had revived in a former experiment.	12 7 0	...	0 6 30	...	...	12 13 37	0 5 0	Chloroformed in the same way. Fell down at 12 h. 11 m. Taken out of box 12 h. 11 m. Artificial respiration commenced 7 s. after respiration had ceased, and proved unsuccessful.
Do.	406	Full-sized, well-nourished pariah.	2 40 0	...	0 0 5	...	...	2 45 20	0 9 0	Chloroformed in the same box. Fell down at 2 h. 43 m. Taken out at 2 h. 44 m. 0 s. and chloroformed on the table. Artificial respiration was commenced 20 s. after respiration had ceased. Dog revived.
Nov. 15.	407	Under-sized, fairly-fed pariah.	9 31 38	0 0 43	0 1 16	...	...	9 33 6	0 5 0	Struggled a great deal. Artificial respiration was commenced 12 s. after the breathing had ceased, and proved successful. Chloroform in large doses with cloth inhaler.
Do.	408	Full-grown, well-nourished pariah.	9 40 30	0 1 2	0 2 0	...	...	9 42 40	0 4 0	Struggled a great deal. Artificial respiration was commenced 10 s. after breathing had ceased and proved successful. Chloroformed in large doses with cloth inhaler.
Do.	409	Full-grown, small, and well-nourished pariah.	9 53 0	0 0 54	0 1 25	...	...	9 54 40	0 3 0	Struggled as usual. Artificial respiration was commenced 15 s. after the breathing had ceased, and proved successful. Chloroformed in large doses with cloth inhaler.
Do.	410	Under-sized, lean pariah.	10 30 0	0 1 0	0 2 4	...	...	10 15 19	0 4 0	Struggled a great deal. Artificial respiration was commenced 15 s. after the breathing had ceased, and proved successful. Chloroformed in large doses with cloth inhaler.
Do.	411	Small, full-grown, well-nourished pariah.	10 33 30	0 0 45	0 2 40	...	...	10 36 30	0 2 0	Struggled as usual. Artificial respiration was commenced 20 s. after the breathing had ceased, and proved successful. Chloroformed as in the above case.
Do.	412	Large-sized, well-nourished pariah.	10 41 0	0 1 35	0 8 12	...	...	10 49 37	0 8 0	Struggled as usual. Artificial respiration was tried 25 s. after the breathing had ceased, and found to be successful.
Nov. 18.	413	Full-sized, healthy pariah.	9 41 0	0 2 20	0 3 50	...	...	9 45 15	0 3 0	Gradual administration of chloroform on cap. Dog struggled very much. Artificial respiration 25 s. after the breathing ceased, and found successful.
Do.	414	Under-sized, badly nourished pariah.	9 50 0	0 1 20	0 2 30	...	...	9 53 0	0 10 0	Chloroform administered gradually as above. Artificial respiration by bellows began 30 s. after breathing stopped, and continued for exactly 10 m. After this needle inserted into heart; no movement. Dog struggled during inhalation. Dog died.
Do.	415	Full-sized well-nourished pariah.	10 7 0	0 2 3	0 2 30	0 5 0	...	10 9 45	0 6 0	Chloroformed gradually as above. Artificial respiration by bellows began 15 s. after breathing stopped and continued for 6 m. No effect. Needle inserted into heart and movements of flag noted. Dog died. Dog struggled as usual during inhalation.
Do.	416	Full-sized, healthy pariah.	10 20 0	0 1 15	0 3 10	...	...	10 23 30	0 5 20	Chloroformed gradually as above. Artificial respiration in the ordinary way began 20 s. after respiration ceased, and continued for 5 m. 20 s. Dog died. Struggled a great deal during inhalation.
Do.	417	Full-grown, large-sized pariah.	10 32 0	0 7 0	0 11 18	...	...	10 43 33	0 4 0	Chloroform given in very small quantities and very gradually, with a large admixture of air. Dog revived. Artificial respiration was commenced 15 s. after the respiration had ceased. Struggled during administration.
Do.	418	Full-grown, large-sized pariah.	10 32 30	0 4 30	0 9 2	...	...	11 1 57	0 3 0	Chloroformed gradually, as in the last case. Artificial respiration was commenced 25 s. after respiration had ceased, and proved successful. Struggled during administration.
Do.	419	Full-grown large-sized pariah.	11 8 0	0 4 12	0 7 33	...	...	11 15 33	0 5 0	Chloroform gradually given, as in the last case. Artificial respiration was commenced 25 s. after the respiration had ceased. Dog died. Struggled during administration.
Do.	420	Ditto.	11 21 0	0 2 40	0 16 2	...	...	11 37 22	0 6 0	Chloroform gradually given, as in the last case. Artificial respiration was commenced 20 s. after respiration had stopped, and proved successful.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Nov. 18.	421	Full-grown large-sized, healthy pariah.	2 32 0	0 5 30	0 7 0	...	...	2 39 20	0 8 0	Chloroform gradually given, as in the last case. Artificial respiration commenced 20s. after respiration had stopped. Dog died. Did not struggle much.
Do.	422	Full-grown, under-sized, fairly nourished. pariah.	2 51 30	0 1 45	0 4 15	...	...	2 56 0	0 1 30	Chloroformed as in the last case. Artificial respiration commenced 15s. after respiration had ceased. Dog revived. Did not struggle very much.
Do.	423	Full-grown, well-nourished pariah.	3 0 0	0 2 30	0 9 14	...	...	3 9 34	0 3 0	Chloroform administered in small doses gradually, as in the last case. Artificial respiration was commenced 20s. after breathing had ceased, and proved successful. Struggled as usual.
Do.	424	Ditto.	3 14 0	0 2 8	0 18 6	...	...	3 32 16	0 2 0	Struggled a great deal. Chloroform was administered as in the last case, and artificial respiration tried 10s. after breathing had ceased. Dog revived.
Do.	425	Full-grown, well-nourished pariah.	3 36 45	0 2 55	0 11 50	...	...	3 49 5	0 3 0	Struggled as usual. Chloroformed as in the previous case. Artificial respiration was commenced 30s. after the breathing had ceased, and proved successful. Artificial respiration continued for 3m.
Do.	426	Ditto.	4 1 0	0 2 3	0 4 8	...	...	4 5 38	0 3 0	Struggled. Artificial respiration was commenced 30s. after the breathing had ceased, but did not prove successful. Chloroformed with a large dose, and with little air.
Nov. 19	427	Full-grown, fairly nourished pariah.	9 48 0	0 1 20	0 2 5	...	...	9 50 20	0 9 0	Dog struggled very much; large dose of chloroform given, with very little air. Artificial respiration commenced 15s. after breathing had ceased. Gave several gasps after 4m. Artificial respiration unsuccessful.
Do.	428	Ditto.	10 6 0	0 6 15	0 13 45	...	...	10 20 0	0 3 30	Chloroform given in measured doses of 1 dr. at a time. Total given 4 dr. Artificial respiration commenced 15s. after breathing had ceased, and proved successful. The doses of chloroform administered at an interval of 4 m. between each dose. Dog struggled slightly.
Do.	429	Large-sized, full-grown well-nourished pariah.	10 26 0	0 3 45	0 12 2	...	...	10 38 7	0 2 0	Chloroform given as in above case. Artificial respiration commenced 5s. after the breathing had ceased. Successful.
Do.	430	The same dog chloroformed a second time as soon as the cornea became sensitive.	10 43 4	0 2 18	0 5 23	...	...	10 48 32	0 2 0	Chloroformed as in the above case, and artificial respiration commenced 5 s. after the breathing had ceased. Successful.
Do.	431	The same dog chloroformed for the third time as soon as the cornea became sensitive.	10 55 0	0 1 43	0 10 3	...	...	11 5 8	0 4 0	Chloroformed as in the last case. Artificial respiration was commenced 5s. after the breathing had ceased, but proved unsuccessful.
Do.	432	Young monkey.	11 13 0	0 0 58	0 2 0	...	...	11 15 5	0 6 0	Chloroformed as in the last case. Artificial respiration was commenced 5s. after the breathing had ceased, but proved unsuccessful. The bellows were used in this case for artificial respiration, and found unsuitable.
Do.	433	Ditto.	11 33 0	0 1 25	0 5 0	...	...	11 38 5	0 4 0	Chloroformed as in the last case. Artificial respiration was commenced 5s. after the breathing had ceased, and proved successful. Artificial respiration was carried on in the ordinary manner with the hands.
Do.	434	Ditto.	12 0 0	0 1 15	0 4 56	...	...	12 5 6	0 3 0	Artificial respiration was commenced 10s. after the respiration had ceased, and was unsuccessful.
Nov. 20.	435	Ditto.	9 26 0	0 8 0	0 17 20	...	...	9 43 50	0 3 0	Chloroform administered in 1 dr. doses at intervals of five minutes, with plenty of air. Artificial respiration commenced 30s. after the breathing had ceased. Animal revived. Total chloroform administered 3drs.
Do.	436	Ditto.	10 23 0	0 1 15	0 1 58	...	...	10 25 28	0 2 0	Chloroform administered as in the last case. Artificial respiration commenced 30s. after respiration had ceased. Proved successful.

VI. (a).—Animals chloroformed for one hour, allowed to revive, and killed with chloroform the next day.

Do.	437	Full-grown pariah dog.	10 5 0	...	...	...	...	...	...	Chloroformed for an hour and allowed to revive for a further observation the next day.
		Nov. 21.	10 28 0	0 0 55	0 2 4	0 2 35	0 4 45	...	...	21st.—Post-mortem made after chloroforming the animal to death. Weight 24 lb. Liver and portal system congested generally; kidneys and spleen congested. Heart: Left side distended with arterial blood, and right side venous. Lungs and trachea were normal.

Date.	No	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889. Nov. 20.	438	Young monkey. Nov. 21.	10 8 0 11 19 0	0 0 58	0 1 45	0 2 40	0 4 10	...	...	Ditto. Weight 5lb. Post-mortem made after chloroforming to death. Post-mortem appearances as in 437.
Do.	439	Full-grown, pariah dog. Nov. 21.	10 0 0 9 57 0	...	...	...	...	...	...	Ditto. 21st.—Chloroformed to death and a post-mortem made. Weight 26 lb. The same post-mortem appearances were noticed as in the last case.
Do.	440	Young monkey. Nov. 21.	10 0 0 11 5 0	0 1 0	0 2 3	0 2 15	0 4 35	...	...	Ditto. 21st.—Chloroformed to death and a post-mortem made. The same post-mortem conditions were noticed as in the last case. Weight 8 lb.
Do.	441	Young monkey. Nov. 21.	10 0 0 10 34 0	0 1 0	0 2 0	0 4 0	0 6 15	...	...	Ditto. 21st.—Chloroformed to death, and a post-mortem made. No difference to be seen in the post-mortem appearance. Weight 8 lb.
Do.	442	Full-grown, large pariah dog. Nov. 21.	10 0 0 10 0 0	...	...	...	...	...	...	21st.—Chloroformed to death, and a post-mortem made. No difference to be seen in the post-mortem appearance. Weight 8 lb. 21st.—Chloroformed to death, and a post-mortem made. Weight 30 lb. Post-mortem appearance as in the other cases.

V. (a).—Artificial respiration tried in this case.

Do.	443	Young monkey.	10 36 0	0 2 50	0 8 2	10 44 32	0 2 0	Chloroformed as in Experiment 436, and artificial respiration commenced 30s. after the breathing had ceased. Monkey revived.
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I (c).—Monkeys kept fasting for twenty-four hours, and chloroformed to death with large doses on cloth cap inhaler.

Do.	444	Young monkey.	10 50 20	0 2 1	0 6 13	0 7 0	0 10 24	...	...	The monkey was fasting for twenty-four hours. Did not struggle.
Do.	445	Ditto.	11 5 0	0 1 56	0 3 18	0 4 2	0 8 16	...	...	Ditto.
Do.	446	Ditto.	11 14 0	0 0 53	0 2 2	0 3 5	0 4 6	...	...	In this case the effect of 1 oz. of chloroform on the cap was tried. Struggled.
Do.	447	Ditto.	11 20 0	0 1 6	0 1 45	0 2 0	0 8 40	...	...	Ditto.

V. (a).—Artificial respiration tried in these cases.

Do.	448	Young monkey.	11 29 0	0 2 6	0 3 20	...	...	11 32 50	0 2 0	Chloroformed in 1 dr. doses every 5 m. on cloth cap, as in Case 443. Artificial respiration was commenced 30 s. after the breathing had ceased, and proved successful. Did not struggle.
Do.	449	Do. Was partially choked when brought on table, and had to be revived.	11 47 0	0 1 3	0 1 52	...	...	11 49 22	0 1 30	Chloroformed as in the previous case. Artificial respiration was commenced 30 s. after the breathing had ceased and proved successful. Did not struggle.
Do.	450	Young monkey.	11 53 0	0 2 0	0 4 14	...	...	11 57 49	0 2 1	Chloroformed as in Experiment 449. Did not struggle. Artificial respiration was tried 35 s. after the breathing had ceased, and proved successful.
Do.	451	Full-grown monkey.	3 11 0	0 1 50	0 5 23	...	...	3 17 3	0 4 0	Struggled a great deal. Chloroformed as in Experiment 450. Artificial respiration was commenced 40 s. after the respiration had ceased, and proved successful.
Do.	452	Do.	3 30 0	0 1 17	0 6 0	...	...	3 36 45	0 3 0	Struggled. Chloroform given as in Experiment 451 and artificial respiration 45 s. after the respiration had ceased. Monkey revived.

VI. (b). Animals kept under the influence of ether for one hour and chloroformed to death the next day.

Do.	453	Large-sized, well-nourished dog. Nov. 21.	3 0 0 10 17 10	...	...	...	...	...	...	Large doses of ether administered for one hour and allowed to recover for further observation. 21st.—Chloroformed to death by large doses of chloroform. Gasped 21 times 4 m. 30 s. after respiration ceased. Did not struggle. Weight 30 lb. Post-mortem appearances—congestion of liver and portal system generally. Kidneys highly congested. The spleen was three times larger than normal and puckered. Trachea and lungs normal. Heart: right side distended with venous blood and left with arterial. The post-mortem appearances corresponded generally with those seen in the animals that had had chloroform the day before instead of ether. Vide VI. (a).
Do.	454	Do.	3 0 0	...	...	...	...	...	...	Large doses of ether administered for one hour and allowed to recover for further observation.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
1889.		Nov. 21st.	10 42 0	0 1 10	0 2 18	0 2 40	0 6 15	...	...	21st.—Chloroformed in the same manner as in the above case. Dog struggled violently. Weight 32 lb. Post-mortem appearances as in the last case, with the exception of the spleen, which was simply congested and not enlarged.
Nov. 20.	455	Do.	3 0 0	...	...	...	...	...	...	Large dose of ether administered for one hour and allowed to recover for further observation.
		Nov. 21st.	10 50 0	0 1 15	0 1 50	0 2 10	0 3 10	...	...	21st.—Chloroformed to death in the same manner as in the last case the next day. Dog struggled violently. Post-mortem appearances as in the last case. Weight 33 lb.
Do.	456	Full-grown, small-sized monkey.	3 0 0	...	...	...	...	...	...	Large dose of ether administered for one hour and allowed to recover for further observation.
		Nov. 21st.	11 27 0	0 1 10	0 3 25	0 3 43	0 5 30	...	...	21st.—Chloroformed in same manner as in above case. Struggled a little. Weight 8 lb. Post-mortem appearances as in the last case.
Do.	457	Small monkey.	3 0 0	...	...	...	...	...	...	Large dose of ether administered for one hour, and allowed to recover for further observation.
		Nov. 21st.	10 57 0	0 1 10	0 3 45	0 4 30	0 4 45	...	...	21st.—Chloroformed as in the above case. Did not struggle at all. Weight 8 lb. Post-mortem appearances as in the last case.
Do.	458	Small monkey.	3 0 0	...	...	...	...	...	...	Large dose of ether administered for one hour, and allowed to recover for further observation.
		Nov. 21st.	11 40 30	0 1 0	0 3 0	0 3 30	0 4 15	...	...	21st.—Chloroformed as above. Weight 5 lb. Post-mortem appearances as in the last case.
V. (a).—Artificial respiration tried in these cases.										
Nov. 22.	459	Medium-sized monkey.	10 0 0	0 2 0	0 12 25	...	...	10 13 5	0 1 0	Chloroform administered in small doses with plenty of air. Artificial respiration commenced 40 s. after respiration had ceased and proved successful. Weight 7 lb.
Do.	460	Small monkey.	10 17 0	0 0 55	0 1 55	...	...	10 19 35	0 13 0	Chloroformed as in above case, but with less air. Artificial respiration commenced 40 s. after respiration had ceased. Unsuccessful.
Do.	461	Medium-sized monkey.	10 25 0	0 2 0	0 6 25	...	...	10 32 10	0 1 40	Chloroformed as in above case. Artificial respiration commenced 45 s. after respiration had ceased and proved successful.
Do.	462	Medium-sized monkey, subject of Experiment 274.	10 39 0	0 1 5	0 2 15	...	...	10 42 5	0 16 0	Chloroformed as in above case. Artificial respiration commenced 50 s. after respiration had ceased. Proved successful. Weight 7 lb.
Do.	463	Full-grown monkey.	12 0 0	0 2 4	0 8 13	...	...	12 9 8	0 10 0	Chloroformed as in above case and artificial respiration commenced 55 s. after the breathing had ceased. Artificial respiration unsuccessful. The monkey gasped four times before he died.
Do.	464	Ditto.	11 20 0	0 1 40	0 9 27	...	...	11 30 22	0 7 0	Chloroformed as in the above case, and artificial respiration commenced 55 s. after the breathing had ceased; unsuccessful.
Do.	465	Ditto.	11 38 0	0 0 53	0 3 0	...	...	11 41 55	0 1 0	Chloroformed as in the above case and artificial respiration commenced 55 s. after the breathing had ceased; monkey revived.
Do.	466	Subject of a former experiment.	11 51 0	0 1 3	0 3 16	...	...	11 55 11	0 2 0	Chloroformed as in the above case and artificial respiration tried 55 s. after the resp. had ceased; proved successful.
VII.—Administration of a definite quantity of chloroform.										
Do.	467	Full-grown, middle-sized pariah.	2 23 0	...	...	...	...	...	...	Chloroformed in a box at 2 h. 23 m. Fell down at 2 h. 30 s. Taken out and placed on the table at 2 h. 31 m. Trachea opened and tube inserted at 2 h. 40 m. A definite quantity of chloroform and air was then administered through the bellows from a box eight cubic feet in capacity, and into which two ounces of chloroform had been placed at 2 h. 45 m. At 3 h. 45 m. the dog was found to be coming out, and another ounce was placed in the box. Needle placed in heart at 4 h. Heart stopped at 4 h. 8 m. 13 s.
Nov. 23.	468	Full-grown, well-nourished pariah.	9 50 0	...	...	...	0 40 0	...	...	Chloroformed in a deal wood box at 9 h. 30 m. Fell down at 9 h. 40 m. Was taken out of the box at 9 h. 45 m. Trachea opened and tube introduced at 9 h. 50 m. Chloroform given as in the last case with bellows and from the tin box. In this case the heart ceased beating, judging from needle in thorax, at 10 h. 20 s., and commenced again after a full minute, and then ceased finally at 10.30 The time of cessation of respiration could not be noted in this nor in the last case on account of bellows being used until death occurred.

V. (a) —Artificial respiration tried in these cases.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Coma became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Nov. 23.	469	Full-grown monkey.	H. M. S. 10 56 0	H. M. S. 0 2 5	H. M. S. 0 4 18	H. M. S. 0 4 30	H. M. S. ...	H. M. S. 11 1 13	H. M. S. 0 2 0	Chloroformed in large doses with cloth inhaler. Artificial respiration was commenced 55 s. after the respiration had ceased, and proved successful. Weight 6 lb.
Do.	470	Ditto.	11 5 0	0 1 25	0 3 40	0 4 1	...	11 9 40	0 2 30	Chloroformed as in the last experiment, and artificial respiration commenced one minute after the respiration had ceased; the monkey revived.
Do.	471	Ditto. Subject of Experiment 469.	11 18 18	0 2 0	0 4 53	Not noted.	...	11 24 11	0 6 0	Chloroformed as in the above experiment, and artificial respiration commenced one minute after the breathing had ceased. Needle in heart stopped vibrating at 11 h. 30 m.; unsuccessful.
Do.	472	Young monkey.	11 31 0	0 1 48	0 6 2	Not noted.	...	11 38 9	0 6 0	Chloroformed as in the above experiment. The respiration in this case ceased after 3 m. 32 s. for 40 s., and commenced again. More chloroform had to be given, and he ceased breathing for the second time after 1 m. 2 s. from time of inhalation. Artificial respiration was commenced 1 m. 7 s. after the breathing had ceased, and proved unsuccessful. Needle in heart at 11 h. 42 m. found to be vibrating.
Do.	473	Ditto.	11 46 0	0 1 35	0 3 23	...	...	11 50 23	0 2 0	Chloroformed as in the above experiment. Artificial respiration was commenced one minute after the breathing had ceased, and proved successful. Struggled.

V. (b).—Artificial respiration tried on dogs poisoned with phosphorus.

Nov. 25.	474	Full-grown, large pariah; has had $\frac{3}{4}$ gr. of phosphorus a day since the 22nd inst.	10 18 0	0 1 0	0 2 53	...	...	10 21 33	0 6 0	Chloroformed in large doses with inhaler tightly held over face. Struggled a great deal. Artificial respiration was commenced one minute after the breathing had ceased, and proved unsuccessful; weight 30 lb. The dog gasped several times after artificial respiration had been practised for a minute. Post-mortem appearances: Liver found ruptured in three places, and the peritoneal cavity full of dark blood. Liver distinctly fatty (mottled), soft, and friable. Heart soft, mottled on surface. Endocardium pale; lung dry and non-crepitant. Lines of medullary rays in kidneys were well marked.
Do.	475	Full-grown, large-sized pariah; has had $\frac{3}{4}$ gr. of phosphorus a day since 22nd inst.	10 43 0	0 1 48	0 2 18	...	...	10 46 18	0 2 0	Chloroformed as in the above experiment, and artificial respiration commenced one minute after the breathing had ceased. The dog was revived after artificial respiration had been practised two minutes. Struggled during inhalation.
Do.	476	Full-grown pariah; has had phosphorus as in the above case.	10 5 20	0 2 30	0 3 0	...	...	10 56 0	0 6 0	Chloroformed as in the last case, and artificial respiration commenced one minute after the breathing had ceased. Dog died. The needle in heart was found to be vibrating until 11 h. 3 m. 12 s. Struggled during inhalation. Weight 30 lb. Post-mortem appearances same as in No. 475, with the exception that the liver was not ruptured.
Do.	477	Ditto.	11 8 0	0 1 52	0 2 52	...	...	11 11 52	0 7 0	Chloroformed as in the last experiment. Artificial respiration was tried 1 minute after the breathing had ceased and proved unsuccessful. Weight 28 lb. Heart acted for 5 minutes after the respiration had ceased. Struggled during inhalation. Post-mortem appearances as in 476.
Do.	478	Full-grown, large pariah; was given phosphorus as in the previous cases.	11 18 0	0 2 1	0 4 1	...	...	11 22 45	0 6 0	Chloroformed as in above case, and artificial respiration tried unsuccessfully 45 s. after the breathing had ceased. Struggled a great deal. Post-mortem appearances as in 477.
Do.	479	Full-grown, large pariah; has had phosphorus as in the last case.	11 32 0	0 2 33	0 3 15	...	...	11 36 0	0 13 0	Chloroformed as in the above case. Artificial respiration was tried 45 s. after breathing had ceased. Needle thrust into the heart at 11 h. 47 m. was seen to be vibrating. Dog died at 11 h. 50 m. 5 s. Weight 22 lb. Post-mortem appearances as in 478.
Do.	480	Full-grown, large pariah; has had the same amount of phosphorus as in the previous cases.	11 51 0	0 1 53	0 2 13	...	...	11 53 51	0 3 0	Chloroformed as in the above cases, and artificial respiration tried 38 s. after the breathing had ceased. The dog revived 2 minutes after artificial respiration had been commenced.

Date	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Nov. 25.	481	Full-grown, large pariah; has had phosphorus as in the previous cases.	II. M. S. 12 0 0	II. M. S. 0 1 3	II. M. S. 0 2 18	H. M. S. ...	H. M. S. ...	H. M. S. 12 2 53	H. M. S. 0 6 0	Chloroformed as in 480. Artificial respiration commenced 35 s. after breathing had ceased. Dog died. Weight 35lb. Post-mortem appearances as in 479.

V. (a).—Artificial respiration tried in these cases without the previous administration of phosphorus.

Do.	482	Young monkey.	3 29 0	0 1 13	0 3 56	...	...	3 33 26	0 3 0	Chloroformed in large doses with cloth inhaler tightly held over the face. Artificial respiration was commenced 30 s. after the breathing had ceased, and proved unsuccessful.
Do.	483	Ditto.	3 39 0	0 0 56	0 4 2	...	...	3 43 32	0 6 0	Ditto. Artificial respiration was commenced 30 s. after the breathing had ceased, and proved unsuccessful.
Do.	484	Ditto.	3 52 0	0 1 0	0 3 39	...	...	3 56 9	0 15 0	Ditto. Artificial respiration was commenced 30 s. after the breathing had ceased and continued 15 m.; proved unsuccessful.
Do.	485	Ditto.	4 8 0	0 1 45	0 4 0	...	...	4 12 30	0 1 0	Ditto. Artificial respiration was commenced 30 s. after the breathing had ceased, and proved successful after a minute.

V. (c).—The abdomen was opened in these cases and aromatic spirits of ammonia injected into the stomach before artificial respiration was tried.

Nov. 26.	486	Full-sized, healthy pariah.	9 47 30	0 1 0	...	...	...	...	...	Operation of opening abdomen begun at 9h. 50m. Cornea sensitive at 9h. 54m. More chloroform at 9h. 54m. 10s. Cornea insensitive, and chloroform removed at 9h. 55m. 30s., 1 dr. spirits ammonia co. being injected into stomach by hypodermic syringe 9h. 58m. 25s. Injection completed at 9h. 59m. 10s. Pushed chloroform at 10h. 4m., dog being still under. Respiration ceased at 10h. 7m. 50s. Artificial respiration commenced 10h. 8m. 20s., 30s. after breathing ceased and continued for 5m. 40s., and proved unsuccessful. Weight 34 lb.
Do	487	Full-sized, healthy pariah.	10 17 0	...	...	...	...	...	...	Chloroform inhalation begun at 10h. 17m. Cornea insensitive 10h. 18m. 10s. Respiration ceased suddenly 10h. 19m., and artificial respiration commenced immediately and continued for 4m. Operation of opening abdomen begun at 10h. 24m. Injection of 1 dr. spirits of ammonia co. begun at 10h. 26m. 30s. into stomach as in above case. Finished at 10h. 27m. Pushed chloroform at 10h. 30m., dog being still under. Respiration ceased at 10h. 46m. 40s. Artificial respiration commenced at 10h. 37m. 0s. after breathing had ceased and continued for 2m. Dog revived. Weight 29 lb.

V. (a) — Artificial respiration tried.

Do.	488	The same dog chloroformed again.	0 46 0	0 0 53	0 3 10	...	...	10 49 40	0 2 0	Chloroformed with large doses and artificial respiration commenced 30s. after the breathing had ceased. Unsuccessful.
Do.	489	Young monkey; weighed 6 lb.	11 1 0	0 0 58	0 2 16	...	...	11 3 46	0 4 0	Chloroformed as in the above experiment. Artificial respiration was commenced 30s. after the respiration had ceased and proved successful.

I. (k) — Monkeys chloroformed to death after the subcutaneous injection of aromatic spirits of ammonia.

Do.	490	Young monkey; had 20 minims of spirits of ammonia aromatic injected under the skin at 11h. 2m.	11 11 0	0 1 18	0 2 16	0 2 23	0 9 23	...	...	Chloroform in large doses till death occurred. Weight 6 lb.; gasped twice before the heart stopped.
Do.	491	Young monkey; had 20 minims of spirits of ammonia co. injected under the skin at 11h. 12m.	11 21 0	0 0 43	0 1 59	0 2 6	0 7 0	...	...	Idem. Weight 8 lb.
Do.	492	Full-grown monkey; had 20 minims of spirits of ammonia aromatic injected at 11h. 20m.	11 28 0	0 1 18	0 2 53	Not noted.	0 10 12	...	...	Idem. Weight 12 lb.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Nov. 26	493	Full-grown monkey; had 20 minims of spirits of ammonia aromatic at 11 h. 25 m.	H. M. S. 11 35 0	H. M. S. 0 1 12	H. M. S. 0 2 27	H. M. S. 0 2 48	H. M. S. 0 15 0	H. M. S. ...	H. M. S. ...	Idem. Weight 12 lb.
Do.	494	Full-grown monkey; small size; had 20 minims of spirits of ammonia co. at 2 h. 45 m.	2 50 0	0 1 0	0 1 30	0 2 10	0 4 0	...	...	Do. Weight 5 lb.
Do.	495	Young monkey; had 20 minims of spirits of ammonia co. at 2 h. 55 m.	3 0 0	0 1 0	0 2 10	0 3 30	0 5 50	...	...	Do. Respiration returned 35 s. after it ceased and continued for 1 m., after which it ceased entirely.

V. (a).—Artificial respiration tried.

Do.	496	Young monkey.	3 14 0	0 0 56	0 1 58	...	...	3 16 28	0 5 0	Chloroformed by 1 dr. doses at a time, the monkey being in the erect position. Artificial respiration was commenced 30 s. after the breathing had ceased, the monkey having been inverted before it was begun. Unsuccessful. The heart stopped beating seven minutes after inhalation. Weight 6 lb.
Do.	497	Ditto.	3 30 0	0 1 5	0 2 11	...	...	3 32 41	0 14 0	Ditto. Artificial respiration commenced 30 s. after the breathing had ceased, the monkey being inverted. Proved unsuccessful. A needle in the heart was found to be vibrating 15 m. after inhalation.
Do.	498	Ditto.	3 57 0	1 4 0	0 3 0	...	...	4 0 30	0 4 0	Ditto. Artificial respiration was commenced 30 s. after the breathing had ceased, the monkey having been inverted, and proved successful.

I. (m).—Monkeys chloroformed to death in the erect position and with large doses on cloth inhaler.

Do.	499	Full-grown monkey.	10 37 0	0 1 30	0 5 0	0 9 30	0 11 15	...	...	Chloroformed in the erect position, and the anæsthetic pushed until death occurred.
Do.	500	Small monkey.	10 55 0	0 1 20	0 3 30	0 5 0	0 6 0	...	...	Do. Do. Weight 5 lb.
Do.	501	Ditto.	11 5 0	0 1 0	0 2 46	0 3 5	0 4 6	...	...	Do. Do. do.
Do.	502	Ditto.	11 13 30	0 1 5	0 1 50	0 3 15	0 3 33	...	...	Ditto. The thorax was opened in this case, and the heart seen to have stopped immediately after the needle in that organ ceased to vibrate. Weight 5 lb.
Do.	503	Young monkey	11 27 0	0 0 52	0 4 18	0 4 23	0 4 40	...	...	Do. Do. Weight 8 lb.
Do.	504	Ditto.	11 43 30	0 1 0	0 6 2	0 6 23	0 10 12	...	...	Do. Do. Weight 6 lb.

V. (a).—Artificial respiration tried in these cases.

Do.	505	Ditto.	11 57 0	0 1 5	0 5 16	...	...	12 2 46	0 5 0	Chloroformed in the recumbent position with large doses and inverted before artificial respiration was begun. Artificial respiration was commenced 30 s. after the breathing had ceased, and proved ineffectual. Weight 7 lb.
Nov. 27.	506	Ditto.	2 51 0	0 1 15	0 5 0	...	...	2 56 30	0 2 0	Chloroformed as above. Proved unsuccessful. Artificial respiration commenced after 30 s. and continued for 2 m.
Do.	507	Full-grown monkey.	3 7 0	0 1 45	0 5 15	...	...	3 13 0	0 7 0	Chloroformed as above. Artificial respiration commenced after 45 s. and continued for 7 m. unsuccessfully.
Do.	508	Young monkey.	3 20 0	0 0 54	0 5 0	...	...	3 28 45	0 4 0	Chloroformed as in the above case, and artificial respiration commenced 45 s. after the breathing had ceased. Successful.
Do.	509	Ditto.	3 32 0	2 44 0	0 6 2	...	...	3 38 22	0 3 0	Chloroformed as in the above case. Struggled a great deal. Artificial respiration was commenced 20 s. after the breathing had ceased, and proved successful. Weight 8 lb.
Do.	510	The same monkey after he had revived.	3 44 0	0 0 42	0 1 14	...	...	3 45 44	0 6 0	Chloroformed as in the above case. Artificial respiration was commenced 30 s. after the breathing had ceased. Unsuccessful.
Do.	511	Full-grown monkey.	3 55 0	0 2 18	0 5 16	...	...	4 1 16	0 2 0	Chloroformed as in the last experiment. Artificial respiration was commenced 1 m. after the breathing had ceased, and found unsuccessful.

V. (b).—Artificial respiration tried on dogs sick from phosphorus poisoning.

Nov. 30.	512	Dog sick from phosphorus poisoning. Had 1 gr. of phosphorus daily for three days from 25th inst.	10 23 0	0 1 40	0 4 15	10 27 40	0 2 0	Struggled. Artificial respiration was commenced 25 s. after the breathing had ceased, and succeeded in reviving the dog.
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Date.	No	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Nov. 30.	513	Ditto.	H. M. S. 10 30 0	H. M. S. 0 1 16	H. M. S. 0 2 4	H. M. S. ...	H. M. S. ...	H. M. S. 10 32 44	H. M. S. 0 1 30	Struggled. Artificial respiration was commenced 40 s. after the breathing had ceased, and proved successful.
	514	Ditto.	10 47 0	0 1 10	0 2 14	...	...	10 50 4	0 7 0	Struggled a great deal. Artificial respiration was commenced 50 m. after breathing had ceased. Dog died. Post-mortem appearances: Liver ruptured. It was soft, friable, and mottled, and distinctly fatty. Heart paler than usual.

V. (e).—Three dogs sick from phosphorus poisoning etherised and artificial respiration tried on them.

Do.	515	Ditto.	11 3 0	0 2 16	0 6 18	...	...	11 9 43	0 6 0	Struggled. Artificial respiration was commenced 25 s. after respiration had ceased, and proved unsuccessful.
Do.	516	Ditto.	11 35 0	0 1 45	0 12 10	...	...	11 47 40	0 2 0	Dog struggled much. Artificial respiration commenced 30 s. after respiration ceased, and continued for 2 m. Proved successful.
Do.	517	Ditto.	3 44 0	0 1 25	0 8 3	...	...	3 52 53	0 6 0	Artificial respiration was commenced 50 s. after the respiration had ceased. Dog died.

III. (g).—Twelve dogs injected with cocaine into the peritoneum about 10 minutes before being chloroformed to death with large doses on cloth inhaler.

Dec. 2.	518	Full-grown, well-nourished pariah.	10 40 0	0 1 10	0 2 10	0 4 5	0 6 10	...	...	Struggled. Cocaine, $\frac{1}{2}$ gr., injected at 10 h. 30 m.
Do.	519	Ditto.	11 1 0	0 1 26	0 2 18	0 4 20	0 8 13	...	...	Struggled very much. Cocaine, $\frac{1}{2}$ gr., injected at 10 h. 30 m.
Do.	520	Full-grown, thin pariah.	11 11 0	0 1 11	0 2 30	0 3 24	0 8 0	...	...	Struggled very much. Cocaine, $\frac{1}{2}$ gr., injected at 11 h.
Do.	521	Small-sized, full-grown pariah.	11 29 0	0 2 0	0 2 40	0 2 50	0 6 10	...	...	Did not struggle. Injected with $\frac{1}{2}$ gr. of cocaine at 11 h. 20 m.
Do.	522	Full-grown, lean pariah.	11 43 30	0 1 0	0 3 56	0 5 18	0 9 2	...	...	Struggled. Cocaine, 1 gr., injected at 11 h. 35 m.
Do.	523	Emaciated, full-grown pariah.	11 55 0	0 1 5	0 6 24	0 6 28	0 10 38	...	...	Struggled. Cocaine, 1 gr., injected at 11 h. 15 m.
Dec. 3.	524	Undersized, ill-nourished pariah.	10 0 0	0 0 52	0 1 50	0 2 12	0 5 20	...	...	Cocaine, $1\frac{1}{2}$ gr., injected at 9 h. 45 m. inhalation. Dog struggled.
Do.	525	Full-sized, well-nourished pariah.	10 9 0	0 1 5	0 1 35	0 1 50	0 5 58	...	...	Cocaine, $1\frac{1}{2}$ gr., injected at 9 h. 58 m. Dog struggled.
Do.	526	Full-grown, powerful pariah.	10 33 0	0 0 50	0 1 40	0 1 58	0 6 5	...	...	Cocaine, $1\frac{1}{2}$ gr., injected at 10 h. 23 m. Gave great trouble in being chloroformed. Struggled a great deal, and had to be held down with much force.
Do.	527	Full-grown, middle-sized pariah.	3 57 30	0 1 40	0 4 31	0 5 0	0 8 28	...	...	Cocaine, 2 gr., injected at 2 h. 43 m. Dog struggled.
Do.	528	Full-grown, well-nourished pariah.	3 9 0	0 0 48	0 2 0	0 2 23	0 8 13	...	...	Cocaine, 2 gr., injected at 2 h. 54 m. Did not struggle.
Do.	529	Full-grown, small-sized pariah.	3 24 0	0 1 14	0 2 18	0 3 6	0 5 33	...	...	Cocaine, 2 gr., injected at 3 h. 6 m. Shortly after the injection the dog became excited. He was then seized with convulsions; fell down at 3 h. 15 m. Did not struggle during the experiment.

III. (h).—Twelve dogs injected with strychnine before being chloroformed to death with large doses on cloth inhaler.

Dec. 3.	530	Full-grown, well-nourished pariah.	3 39 0	0 1 2	0 1 40	0 2 5	0 4 3	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 3 h. 35 m. Struggled.
Do.	531	Ditto.	3 47 0	0 1 41	0 3 0	0 0 32	0 6 18	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 3 h. 30 m. Struggled.
Do.	532	Ditto.	4 2 0	0 0 59	0 1 42	0 2 18	0 5 31	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 3 h. 43 m. Struggled severely.
Do.	533	Full-grown, large-sized pariah.	4 15 0	0 0 54	0 1 43	0 1 51	0 6 33	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 4 h. 6 m. Struggled.
Do.	534	Full-grown, well-nourished pariah.	4 23 0	0 0 48	0 1 52	0 2 0	0 5 30	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 4 h. 12 m. Struggled.
Dec. 4.	535	Full-grown, powerful pariah.	10 15 0	0 1 15	0 1 40	0 2 0	0 4 44	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 10 h. 6 m. Struggled very hard. Gapsed after the respiration had ceased, and before the heart stopped acting.
Do.	536	Full-grown, small pariah.	10 55 0	0 0 58	0 1 23	0 2 16	0 3 2	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 10 h. 45 m. Muscles rigid, and symptoms of strychnine poisoning commencing when brought on table.
Do.	537	Full-grown, well-nourished pariah.	11 3 0	0 1 18	0 2 4	0 2 17	0 6 0	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 10 h. 55 m. Brought on table with symptoms of strychnine poisoning.
Do.	538	Full-grown, small pariah.	11 12 0	0 0 30	0 2 0	0 2 8	0 4 10	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 11 h. 5 m. Became convulsed at 11 h. 9 m. from strychnine poisoning, and was chloroformed in this condition.
Do.	539	Full-grown, large-sized pariah.	11 16 0	0 0 32	0 2 58	0 3 6	0 5 23	...	...	Strychnine, $\frac{1}{10}$ gr., injected at 11 h. 15 m. Tetanic convulsions set in in a minute's time, and the dog was at once chloroformed.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Dec. 4.	540	Full-grown pariah.	H. M. S. 11 20 0	H. M. S. 0 0 45	H. M. S. 0 0 53	H. M. S. 0 1 56	H. M. S. 0 5 0	H. M. S. ...	H. M. S. ...	Strychnine, $\frac{1}{4}$ gr., injected at 11 h. 18 m. Tetanic convulsions set in in $\frac{1}{4}$ minutes 1st time, and the dog was chloroformed in this condition. Gaspd 13 times before the heart ceased to beat.
Do.	541	Full-grown, small-sized pariah.	11 33 0	0 0 42	0 2 12	0 3 7	0 6 53	...	...	Strychnine, $\frac{1}{4}$ gr., injected at 11 h. 23 m. Chloroformed during convulsions.

III. (i).—*Atropine injected in these cases before the dogs were chloroformed to death with large doses on cloth inhaler.*

Do.	542	Ditto.	11 41 0	0 1 53	0 2 10	0 3 18	0 5 53	...	...	Atropine, $\frac{1}{2}$ gr., injected at 11 h. 30 m. Struggled.
Do.	543	Full-grown, well-nourished pariah.	11 46 0	0 0 58	0 2 33	0 4 0	0 6 2	...	...	Atropine, $\frac{1}{2}$ gr., injected at 11 h. 35 m. Dog struggled.
Do.	544	Full-grown, small pariah.	11 52 0	0 0 53	0 3 0	0 3 15	0 4 7	...	...	Atropine, $\frac{1}{2}$ gr., injected at 11 h. 40 m. Dog struggled.
Dec. 5.	545	Full-grown, well-nourished pariah.	10 13 0	0 1 15	0 2 45	0 3 11	0 4 34	...	...	Atropine, $\frac{1}{16}$ gr., injected at 10 h. 3 m. Dog struggled during administration.
Do.	546	Full-grown, large, but emaciated pariah.	10 19 0	0 43 0	0 1 0	0 1 28	0 3 33	...	...	Atropine, $\frac{1}{16}$ gr., injected at 10 h. 7 m. Struggled during the administration, gasped before the heart stopped beating.
Do.	547	Full-grown, fair-sized pariah.	10 28 0	0 1 21	0 3 23	0 3 47	0 5 59	...	...	Atropine, $\frac{1}{16}$ gr., injected at 10 h. 16 m. Dog struggled.
Do.	548	Full-grown, badly nourished pariah.	10 37 0	0 1 1	0 1 46	0 2 0	0 4 46	...	...	Atropine, $\frac{1}{2}$ gr., injected at 10 h. 23 m. Dog struggled. Gaspd before death.
Do.	549	Full-grown, emaciated pariah.	10 44 0	0 1 9	0 1 38	0 2 2	0 4 16	...	...	Atropine, $\frac{1}{2}$ gr., injected at 10 h. 35 m. Struggled during the administration.
Do.	550	Large-sized, badly nourished pariah.	10 50 0	0 0 42	0 1 13	0 1 20	0 5 12	...	...	Atropine, $\frac{1}{2}$ gr., injected at 10 h. 38 m. Struggled. Gaspd before death occurred.
Do.	551	Large-sized, well-nourished pariah.	11 0 0	0 1 16	0 2 18	0 2 50	0 5 0	...	...	Atropine, $\frac{1}{2}$ gr., injected at 10 h. 48 m. Dog struggled.
Do.	552	Fair-sized, well-nourished pariah.	11 8 0	0 0 48	0 1 36	0 1 42	0 6 18	...	...	Atropine, $\frac{1}{2}$ gr., injected at 10 h. 55 m. Struggled very much. Gaspd three times before the heart stopped.
Do.	553	Small-sized, very emaciated pariah.	11 13 0	0 1 2	0 1 28	0 1 32	0 2 20	...	...	Atropine, $\frac{1}{2}$ gr., injected at 11 h. Struggled in the usual way. As soon as the needle ceased to vibrate the thorax was opened, and the heart seen to have stopped acting. A post-mortem examination was made, and the heart and other organs found healthy.

V — *Morphine injected in these cases and artificial respiration tried. (The chloroform was administered in the usual way on cloth cap inhaler)*

Do.	554	Large-sized, powerful pariah.	11 6 0	0 1 43	0 3 0	...	11 9 30	0 8 0	...	Morphine, $\frac{1}{2}$ gr., injected at 11 h. 52 m. Dog excited when brought on table and struggled very much during the administration of chloroform. Artificial respiration was commenced 30 s. after the breathing had ceased.
Do.	555	Full-grown, well-nourished pariah.	3 40 0	0 0 48	0 1 33	...	...	3 42 3	0 5 0	Morphine, $\frac{1}{2}$ gr., injected at 3 h. 30 m. Artificial respiration was commenced 30 s. after the breathing had ceased. Needle in heart at 3 m. 47 s. ceased to vibrate; unsuccessful. Struggled during administration.
Do.	556	Large-sized, full-grown pariah.	3 51 0	0 1 0	0 2 11	...	...	3 53 41	0 7 0	Morphine, $\frac{1}{2}$ gr., injected at 3 h. 37 m. Artificial respiration was commenced 30 s. after the breathing had ceased. Dog struggled during the administration. Needle in heart at 4 h. ceased to vibrate; unsuccessful.
Do.	557	Full-grown, fair-sized pariah.	4 0 0	0 0 53	0 1 11	...	...	4 1 31	0 4 0	Morphine, $\frac{1}{2}$ gr., injected at 3 m. 50 s. Struggled during the administration. Artificial respiration was commenced 20 s. after the breathing had ceased; successful.
Do.	558	Full-grown, well-nourished pariah.	4 10 0	0 0 56	0 2 0	...	...	4 12 20	0 5 0	Morphine, $\frac{1}{2}$ gr., injected at 4 h. Struggled. Artificial respiration was commenced 20 s. after the breathing had ceased. Needle in heart at 4 h. 17 m. did not vibrate; unsuccessful.
Do.	559	Full-grown, well-nourished pariah.	4 21 0	0 1 13	0 2 17	...	...	4 23 37	0 5 0	Morphine, $\frac{1}{2}$ gr., injected at 4 h. 9 m. Struggled. Artificial respiration was commenced 20 s. after the breathing had ceased. Needle in heart at 4 h. 28 m. did not vibrate.
Do.	560	Full-grown, fair-sized pariah.	4 32 0	0 0 57	0 3 14	...	...	4 35 29	0 4 0	Morphine, $\frac{1}{2}$ gr., injected at 4 h. 20 m. Struggled. Artificial respiration was commenced 15 s. after the breathing had ceased; successful.
Do.	561	Full-grown, emaciated pariah.	4 41 0	0 1 5	0 5 52	...	...	4 47 17	0 3 0	Morphine, $\frac{1}{2}$ gr., injected at 4 h. 30 m. Struggled. Artificial respiration was commenced 15 s. after the breathing had ceased; successful.

Date.	No	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889.			H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
Dec. 5.	562	Full-grown, large pariah, well-nourished.	4 52 0	0 1 3	0 1 23	...	...	4 53 38	0 6 0	Morphine, $\frac{1}{2}$ gr., injected at 4 h. 40 m. Artificial respiration was commenced 15 s. after the breathing had ceased. Dog struggled; unsuccessful.
Dec. 6.	563	Full-grown, well-nourished pariah.	10 40 0	0 0 57	0 3 6	...	...	10 43 36	0 10 0	Morphine, $\frac{1}{2}$ gr., injected at 10 h. 25 m. Struggled. Artificial respiration was commenced 30 s. after the breathing had ceased; unsuccessful.
Do.	564	Full-grown, fair-sized pariah.	11 57 0	0 1 9	0 2 2	...	...	11 59 32	0 6 0	Morphine, $\frac{1}{2}$ gr., injected at 10 h. 38 m. Struggled. Artificial respiration was commenced 30 s. after the breathing had ceased. Successful. This dog died 2 m. after it was taken outside and left alone.
Do.	565	Full-grown, well-nourished pariah.	11 7 0	0 1 10	0 2 26	...	...	11 9 56	0 4 0	Morphine, $\frac{1}{2}$ gr., injected at 10 h. 50 m. Struggled. Artificial respiration was commenced 30 s. after the respiration had ceased. Needle in heart at 11 h. 16 m. ceased to vibrate. Unsuccessful.

V, (b).—Artificial respiration tried on a dog poisoned with phosphorus, the chloroform being administered in the usual manner.

Dec. 7.	566	Full-grown, well-nourished pariah, ill from phosphorus poisoning.	10 49 0	0 0 58	0 2 5	10 51 35	0 12 0	1 gr. of phosphorus given every morning for three days (3rd, 4th, 5th). Did not struggle. Artificial respiration was commenced 30 s. after the breathing had ceased; unsuccessful.
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I. (n).—Dogs chloroformed to death with small doses on cloth inhaler.

Dec. 9.	567	Under-sized, ill-nourished pariah.	10 32 0	0 0 55	0 2 55	0 3 0	0 6 16	Chloroform administered gradually, on a cap with plenty of air. Dog struggled as usual. Gaspd twelve times before heart ceased, the last gasp at 10 h. 36 m. 15 s., or 1 m. 55 s. before heart ceased beating. Weight, 20 lb.
Do.	568	Full-sized, fairly nourished pariah.	10 40 20	0 1 50	0 3 50	0 6 40	0 8 50	...	...	Chloroformed as in the above case. Dog struggled slightly. Weight, 26 lb.
Do.	569	Full-sized, well-nourished pariah.	10 51 0	0 1 40	0 4 50	0 5 2	0 9 40	...	...	Chloroformed as in the above case. Dog struggled very much. Weight, 26 lb.
Do.	570	Full-sized, well-nourished pariah.	11 4 30	0 0 45	0 2 30	0 2 35	0 6 10	...	...	Chloroformed as in the above case. Dog struggled as usual. Gave one long gasp at 11 h. 6 m. 45 s., or 3 m. 55 s. before heart ceased. In this case the needle ceased vibrating at 11 h. 9 m. 15 s., when the thorax was opened and the heart found to be contracting until 11 h. 10 m. 40 s.
Do.	571	Full-grown, well-nourished pariah.	11 14 0	0 1 0	0 18 31	0 19 14	0 26 35	...	...	Chloroformed in small doses gradually given with plenty of air in cloth cap. Struggled. Thorax opened in this case, and the action of the heart watched to the end. Weight, 28 lb.
Do.	572	Full-grown, small-sized pariah.	11 40 0	0 2 29	0 4 32	0 5 4	0 7 52	...	...	Chloroform given as in the above case. Struggled feebly. Thorax opened, and the heart's action watched to the end. Weight, 20 lb.
Do.	573	Ditto.	11 51 0	0 1 33	0 8 13	0 9 0	0 13 28	...	...	Chloroformed as in the previous case. Struggled. Thorax opened after the needle ceased to vibrate, and the heart found to have stopped acting. Weight, 17 lb.
Do.	574	Small and emaciated pariah.	12 17 0	0 1 11	0 4 40	0 5 3	0 8 6	...	...	Chloroformed as in the previous case. Struggled. Thorax opened after the needle ceased vibrating, and the heart's action stopped. Weight, 18 lb.
Do.	575	Small, but full-grown, pariah.	3 13 0	0 1 13	0 11 3	0 11 55	0 18 22	...	...	Chloroformed in a similar manner. Struggled. Thorax opened after the needle ceased to vibrate. Weight, 17½ lb.
Do.	576	Full-grown, large-sized pariah.	3 36 0	0 1 28	0 3 47	0 3 59	0 7 4	...	...	Chloroformed in a similar manner. Struggled very much. Thorax opened after the needle ceased to vibrate. Weight, 28 lb.
Do.	577	Full-grown, well-nourished pariah.	3 45 0	0 2 16	0 3 0	0 3 15	0 7 11	...	...	Chloroform administered as in the previous case. Struggled. Gaspd before the heart ceased to beat. Thorax opened after the needle ceased to vibrate. Weight, 21½ lb.
Do.	578	Full-grown, large-sized pariah.	3 56 0	0 1 2	0 10 8	0 10 24	0 14 3	...	...	Chloroformed in the same way. Struggled. Weight, 30 lb.
Do.	579	Full-grown, small, and emaciated pariah.	11 6 0	0 3 42	0 8 13	0 8 32	0 12 9	...	...	Chloroformed as in 578. Struggled. Thorax opened after the needle ceased to vibrate. Weight, 20 lb.
Do.	580	Full-grown, well-nourished pariah.	11 20 0	0 1 10	0 3 54	0 6 2	0 6 53	...	...	Chloroformed as in the above case. Struggled severely, and had to be held down with great force. Weight, 29 lb.
Do.	581	Full-grown, well-nourished pariah.	3 3 0	0 1 52	0 8 4	0 9 0	0 12 8	...	...	Chloroform given as in the above case. Struggled severely, and had to be held down with force.

Date.	No.	Description of dog.	Time at which inhalation commenced.	Cornea became insensible after—	Respiration ceased after—	Pulse stopped after—	Heart ceased beating after—	Artificial respiration commenced at—	Artificial respiration continued for—	Remarks.
1889. Dec. 11.	582	Full-grown, well-nourished pariah.	H. M. S. 10 37 0	H. M. S. 0 0 58	H. M. S. 0 2 15	H. M. S. 0 3 3	H. M. S. 0 7 14	H. M. S. ...	H. M. S. ...	Chloroformed in small doses on cloth cap inhaler. Struggled very much, and had to be held down forcibly. Weight, 30lb.
Do.	583	Ditto.	10 47 0	0 1 38	0 4 18	0 4 56	0 10 21	...	...	Chloroformed similarly. Struggled. Weight, 26lb.
Do.	584	Full-grown, small pariah.	11 1 0	0 1 0	0 4 6	0 4 23	0 13 42	...	...	Chloroformed similarly. Struggled. Weight, 19lb.
Do.	585	Full-grown, large pariah.	11 16 0	0 1 7	0 2 5	0 2 47	0 8 50	...	...	Chloroformed similarly. Struggled. Weight, 35lb.
Do.	586	Full-grown, well-nourished pariah.	11 27 0	0 1 47	0 4 31	0 4 52	0 8 16	..	...	Chloroformed similarly. Struggled very much. Gapsed before heart ceased beating. Weight, 32lb.
Do.	587	Ditto.	11 37 0	0 2 51	0 8 41	0 8 59	0 12 4	...	...	Chloroformed similarly. Struggled. Weight, 31lb.
Do.	588	Ditto.	11 53 0	0 2 2	0 5 53	0 6 0	0 15 31	...	...	Chloroformed similarly. Struggled. The respiration returned in this case at 12h 2m., and continued for 3m., when the chloroform was renewed in the cap. Weight, 28lb.

DESCRIPTION

OF

MANOMETER EXPERIMENTS.

In these experiments the left carotid artery was connected with two manometers by means of a Y tube—the Ludwig or slow manometer, the tracing of which runs from left to right, and the Fick or rapid manometer, the tracing of which runs from right to left. The connexion of the artery with the Ludwig manometer was continuous, except at short intervals, shown in the Ludwig tracing by a horizontal line with a figure above it. In these short intervals the Ludwig connexion was shut off, and a tracing was taken on the Fick. For example, in Experiment 148 at 3 h. 32 m. 0 s. the Ludwig was turned off. This is shown by a horizontal line with the figure 4 above it. The figure 4 in Fick Tracing I. shows the tracing taken on the Fick during the interval marked 4 in the Ludwig at 3 h. 32 m. 0 s.; and so on. As a rule, the Ludwig manometer was cut off by turning the tap while taking a reading with the Fick manometer; but as the drum was allowed to run, each Fick reading is represented by a straight line on the Ludwig tracing.

October 25th.—No. 25.

Full-sized strong pariah. Into the box with chloroform freely on blotting paper in order to quiet him at 2 h. 25 m. 10 s. Taken out of the box at 2 h. 36 m. and fastened upon the dog-board, chloroform being given from time to time on Junker's inhaler to keep him quiet. Connexion between carotid artery and manometer effected at 2 h. 57 m. Five tracings with the Ludwig or mercurial manometer¹ made showing the effects on the blood-pressure of the following proceedings noted:—

- (a) Ordinary chloroform inhalation.
 - (b) Pushing chloroform until respiration ceased.
 - (c) Artificial respiration until natural breathing was restored.
 - (d) Evulsion of three toe-nails.
 - (e) Ligature of mucous membrane of the anus.
 - (f) Snipping off two portions of anal skin.
 - (g) Free opening of the abdomen and complete ligature of intestine.
 - (h) Continued administration of chloroform until death.
- Respiration ceased at 4 h. 30 m. 50 s., after which the pulse continued feebly, but owing to clotting has not been recorded on the tracing. Death after a few minutes, but not exactly recorded.

October 26th.—No. 29.

Large cream-coloured dog chloroformed in the box at 2 h. 15 m. Taken out of the box and put on the dog-board at 2 h. 39 m. 40 s., and kept under chloroform in the ordinary way with Junker's inhaler. Canula inserted into carotid artery at 2 h. 51 m., and connexion made with both the Ludwig and the Fick manometers through a Y tube² at 2 h. 58 m. Trace No. I. Ludwig shows the effect of evulsion of the toe-nails. Trace No. II. Ludwig the effect of snipping the anus, the administration of large doses of chloroform, and of killing the dog with chloroform. A clot formed in the canula at 3 h. 15 m. 55 s. shortly before the dog died. Four readings were taken with the Fick manometer—1 and 2 while the dog was quietly under chloroform, and 3 and 4 during the operation of snipping the anus.

October 26th.—No. 30.

Full-sized healthy pariah. Into chloroform box at 3 h. 39 m. Taken out of the box and put on the table at 3 h. 4 m. 50 s. and kept under chloroform in the usual way. Dog fully under at 3 h. 50 m. 40 s., and tying of the carotid artery commenced. Canula inserted at 3 h. 58 m. 50 s., and connexion made with the manometers at 4 h. 3 m.

Tracing I. Ludwig shows effect of a large dose of chloroform; but it was soon turned off, and the observations until the death of the animal recorded on the Fick tracing I.

¹ The Fick elastic spring manometer was not connected in this experiment.

² For a full description of the arrangement of the manometers, see Method of Experimentation, page 9.

October 28th.—No. 31.

Temperature of the room 18.5 to 20.5 Cent. Full-sized pariah which had a daily dose of phosphorus (about a quarter of a pot of James' phosphorus paste) for the previous three days, and was, in consequence, very weak and thin. Chloroformed in a box at 7 h. 35 m. Fell down at 7 h. 41 m. 50 s. Placed on dog-board at 7 h. 45 m. and kept quietly under chloroform. Carotid tied and canula inserted at 7 h. 55 m. 30 s. Connexion with manometers made at 8 h. 1 m., at which the cornea was still sensitive, and the animal breathing quietly, but very slowly, about 8 times per minute. Two tracings Ludwig, one Fick. Trace I. Ludwig shows effect of (a) evulsion of the nails, (b) snipping of the anus, (c) extraction of teeth, and includes four Fick readings. Trace II. Ludwig (commencing at 8 h. 32 m. 34 s.) shows effect of (d) change to the vertical position, and while in that position (e) extraction of teeth, and (f) administration of chloroform until death. Post-mortem—Heart flabby, but otherwise normal; lungs—lower and middle lobes, right side, consolidated; liver—drier than in other animals, mottled, buff-colour; kidneys congested, pyramidal portion of a yellowish colour; stomach—distended with dark fluid, not apparently inflamed.

Observations.

- | | | |
|----|-----------|------------------------------------|
| A. | 8 3 50.— | Evulsion of nail. |
| B. | 8 8 20.— | Anus snipped. |
| C. | 8 15 0.— | Evulsion of nail. |
| D. | 8 23 25.— | Extraction of tooth. |
| E. | 8 33 0.— | Change to vertical position. |
| F. | 8 38 0.— | Tooth extracted. |
| G. | 8 41 50.— | Artery cut, pressure fell to zero. |

In Experiment 31 all attempts to produce shock under chloroform in any stage of the administration failed.

October 28th.—No. 32.

Large black dog, well nourished and believed to be healthy. Into chloroform box at 10 h. 46 m. 15 s. Struggling violently at 10 h. 52 m. 30 s. Breathing stopped and artificial respiration resorted to until 10 h. 54 m., when he began again to breathe spontaneously and was placed on the dog-board. More chloroform in cap at 11 h. 1 m. 30 s. Dog struggling. Chloroform stopped at 11 h. 2 m. 30 s. Stertorous breathing. Carotid ligature at 11 h. 7 m. 30 s. Canula inserted 11 h. 10 m. 35 s. Trace No. I. commenced at 11 h. 12 m. 20 s. Dog struggling. Drum changed and Trace No. II. commenced at 11 h. 37 m. 15 s. Canula taken out at 11 h. 52 m. 15 s. Dog not quite dead, heart pulsating, chloroform stopped, and made an attempt to reintroduce canula, but dog dead. Two Ludwig and one Fick tracing. Trace I. Ludwig shows effect of (a) administration of chloroform, (b) artificial respiration, (c) evulsion of nails, (d) placing the animal in the vertical position and includes Fick readings Nos. 1 to 6. Trace II. Ludwig shows effect of (e) continued administration of chloroform with at the same time (f) hemorrhage from the femoral artery, and includes Fick readings Nos. 7 to 9.

Observations.

- | | | |
|----|-------------------------------|--|
| A. | 11 12 20.— | Chloroform pushed to stoppage of respiration and recovery with artificial respiration. |
| B. | 11 18 0.— | Chloroform again; and evulsion of nails at 11 h. 21 m. 0 s., 11 h. 21 m. 40 s., 11 h. 22 m. 0 s., and 11 h. 22 m. 30 s., without any effect. |
| C. | 11 23 40.— | Chloroform in vertical position. |
| D. | 11 25 0 and 11 h. 25 m. 40 s. | evulsion of nails. |
| E. | 11 40 0.— | Chloroform: during this administration the femoral artery was opened and the effects of bleeding observed. The experiment ended at 11 h. 52 m. 15 s. |

October 28th.—No. 33.

Strong, full-sized dog. Put under chloroform at 2 h. 48 m. 30 s. Dog removed from the box and put on the table at 2 h. 56 m., and kept quiet with chloroform on the cap from time to time. Carotid tied at 3 h. 1 m. 30 s. Artificial respiration at 3 h. 3 m. 15 s. Breathing naturally again at 3 h. 4 m. 30 s. Canula inserted at 3 h. 7 m. 30 s. Still having chloroform from time to time. Connexion made with the manometer at 3 h. 8 m. 30 s. The Ludwig tracing shows the effect of (a) ordinary chloroform inhalation, (b) pressure on the abdomen, (c) inversion of the body, (d) administration of ether until death resulted. Post-mortem—Vegetations on pulmonary valves, one of the valves being adherent to

the wall of ventricle. The Fick tracing has seven readings in it, which are fully explained on the tracing. Fick 7, taken when ether was pushed, shows exactly the same slowing of the pulse when the respiration has stopped as occurs with chloroform.

Experiment 33 shows the condition of semi-anesthesia produced by ether held rather closely over the mouth. If more perfect anesthesia is required it can be procured by more rigid exclusion of air; but then there is exactly the same danger as in giving chloroform. How very rapidly the pressure may fall and death ensue from ether is shown when the anesthetic was pushed and air excluded at the end of the experiment.

October 28th.—No. 34.

Full-sized, fairly-nourished pariah dog. Chloroform in box 3 h. 52 m. 15 s. Removed from the box and put on the table and kept under chloroform in the usual way. Artery tied at 4 h. 8 m. 45 s. Canula inserted at 4 h. 9 m. 45 s. Connexion made with the manometers at 4 h. 11 m. 30 s. Trace I. Ludwig shows effects of ether and chloroform alternately, and finally death from chloroform, and includes 12 Fick readings. Trace I. Fick gives the whole of the 12 Fick readings in four revolutions of the drum.

October 29th.—No. 35.

Full-sized healthy pariah. Put into the chloroform box at 8 h. 18 m. 30 s. Fallen down at 8 h. 22 m. 40 s. Placed on the dog-board at 8 h. 24 m. 18 s. and kept quiet with chloroform from time to time. Dog was found to be whining even when the cornea was insensitive and breathing stertorous, although chloroform had not been given for some minutes. Carotid ligatured at 8 h. 40 m. 30 s. No. I. Ludwig shows effects of application of bicarbonate of soda to the vagus; electrical stimulation of the vagus and of chloroform administration; and includes five Fick readings. Tracing No. II. shows the effect of applying an ammonia bottle to the nose and of giving chloroform until death, and includes Fick readings Nos. 6 to 9. Tracing No. III. Ludwig is not preserved, but a partial tracing (III. Fick) reading No. 10 is included in the Fick tracing of dog No. 36.

October 29th.—No. 36.

Temperature of the room 25 Cent. Full-sized pariah rather thin. Into chloroform box 10 h. 45 m. 30 s. Taken out of box and placed on the dog-board 10 h. 56 m. 15 s. and given chloroform on a cap from time to time. Struggling and crying, although cornea nearly insensitive. Carotid ligatured at 11 h. 4 m. 5 s. Canula inserted at 11 h. 10 m. 50 s., and connexion with manometers made at 11 h. 26 m. 20 s. Canula accidentally slipped out of the artery at 11 h. 40 m. 30 s. Dog kept quiet under chloroform and connexion again made at 11 h. 50 m. 30 s. Two Ludwig and two Fick tracings during (a) application of carbonate of soda to the entire vagus nerve; (b) administration of chloroform; (c) electrical irritation of the right vagus; (d) ligature and division of both vagi; (e) irritation of the peripheral ends of the two vagi separately; (f) irritation of the peripheral end of left vagus when the animal was kept under chloroform; (g) irritation of the central ends of the two vagi separately; and, finally, (h) administration of chloroform continuously until death.

October 29th.—No. 37.

Temperature of room 26 Cent. Full-grown common monkey. Given chloroform on a cap while in the cage. Placed on the table 3 h. 2 m. 30 s. and kept quiet under chloroform as before until connexion made with the manometer at 3 h. 59 m. 50 s. Two Ludwig and one Fick tracings. Trace I. Ludwig shows effect of (a) ordinary chloroform administration, (b) evulsion of toe-nail, (c) irritation of the entire vagus, and includes five Fick readings. Trace II. shows effects of (d) administration of ether, but is much interrupted by accidents to the apparatus. It includes Fick readings 5 to 8. Manometer given up on account of clots at 4 h. 53 m. Cornea sensitive at 4 h. 54 m. 15 s. Chloroform given at 4 h. 54 m. 30 s. Pulse perceptible but breathing purely laryngeal at 4 h. 57 m. 45 s. No pulse at 4 h. 59 m. Heart inaudible at 5 h., but a thin stick on a needle thrust into the heart continued to vibrate regularly till 5 h. 1 m.

October 30th.—No. 38.

Temperature of the room 25 Cent. Full-sized pariah dog. Chloroformed in the box at 7 h. 4 m. Placed on the table at 7 h. 51 m. 40 s. and kept quiet with chloroform. Jugular vein ligatured. Connexion made with manometers at 8 h. 45 m. 10 s. Manometer stopped at 9 h. 45 m. Dog killed with chloroform. Respiration stopped 9 h. 26 m. 30 s. Pulse stopped 9 h. 29 m. Heart stopped 9 h. 30 m. 40 s. One Ludwig and one Fick tracing during (a) ordinary chloroform administration; (b) irritation of left vagus with the secondary coil distant from the primary 15 centimeters. The Fick tracing consists of three readings:—

1. A failure.
2. Irritation of left vagus, coils 15 cent. distant.
3. Irritation of left vagus, coils 10 cent. apart.

This last reading was, however, interrupted by clotting.

October 30th.—No. 39.

Large fairly-nourished pariah. Chloroformed and placed upon the table at 10 h. 14 m. Jugular vein tied and canula inserted into carotid. Connexion made with manometer at 10 h. 53 m. Animal eventually killed with ether. Two Ludwig and two Fick tracings. Trace I. Ludwig shows the effects of (a) irritation of the left vagus with the coils 10 cent. apart; (b) injection of physostigmine into the jugular vein; (c) lifting the vagus from its bed; and includes 6 Fick readings, which show the effect of (d) irritation of the entire left vagus; (e) application of saturated solution of carbonate of soda to the vagus. Trace II. Ludwig shows effect of (f) ligature of left vagus; and (g) inhalation of chloroform with rapid but temporary falls of pressure that frequently occur when animals hold their breath at the commencement of the administration. It includes Fick readings 7 to 10, which show the effect of (h) pinching the vagus with forceps; (i) irritation of the peripheral end of the vagus; (j) evulsion of the toe-nails; (k) gradual death from ether.

October 30th.—No. 40.

Temperature of the room 26 Cent. Full-sized pariah dog, the same that had been used in Experiments Nos. 25, 26, and 27, in which experiments he had shown a remarkable power of recovering after chloroform had been pushed until he was to all appearance dead. Chloroformed in box at 1 h. 59 m. 42 s. Lying down at 2 h. 5 m. and placed on the table at 2 h. 5 m. 25 s., being quite under and with its cornea insensitive. Chloroform given from time to time. Artery ligatured at 2 h. 25 m. 15 s.

Artificial respiration at 2 h. 35 m., but breathing spontaneously at 2 h. 38 m. 40 s. Connexion made with manometer at 2 h. 45 m. 40 s. Artificial respiration was again employed at 2 h. 55 m. 30 s. during an interruption in the tracing, but breathing became natural again at 2 h. 56 m. Drum changed at 3 h. 18 m. 30 s., and during interruption sciatic nerve exposed. Drum changed again at 3 h. 53 m. 20 s. Three Ludwig tracings and three Fick. Animal just coming out of chloroform.

H. M. S.

- A. 2 45 40.—Inversion of the body, *vide* Fick 3.
- B. 2 59 30.—Do do.
- C. 3 5 0.—Irritation of left vagus (entire) with coils distant 15 cent. It is doubtful if the irritation was efficient.
- D. 3 7 0.—Irritation of the vagus after administration of physostigmine.
- E. 3 9 30.—Evulsion of toe-nail.
- F. 3 29 0.—Irritation of the exposed sciatic nerve with gradually increased strength of current; coil 15, 10, 5, and 0.
- G. 4 11 0.—Irritation of left vagus, coil 15 after another dose (1-50th of a grain) of physostigmine.
- H. 4 21 0.—Irritation of sciatic nerve again, coil 15.
- I. 4 21 50.—Chloroform administered for 35 seconds.
- J. 4 25 0.—Chloroform pushed. The respiration stopped at 4 h. 27 m. 15 s. After this there were occasional gasps, and at 4 h. 29 m. 30 s. the needle in the heart stopped moving. Artificial respiration was commenced at 4 h. 30 m. 10 s. The animal quickly recovered and breathed naturally at 4 h. 31 m. 15 s.
- K. 4 37 0.—Ether administered. Respiration again ceased temporarily.
- L. 4 42 0.—Chloroform pushed again till death.

Experiment No. 40 was frequently interrupted by clots forming in the tubes. The experiment shows how very remarkable the success of artificial respiration is in some apparently hopeless cases in restoring the circulation. During Fick 12 the heart had ceased beating after the administration for two minutes of concentrated chloroform vapour. Everybody thought the dog was dead, but he was easily restored by artificial respiration. Before the observation at Fick reading 12, the animal had been kept under chloroform off and on for two hours and a half; and for the two minutes immediately preceding the stoppage of the heart it had been pushed regardless of the breathing. The explanation of the easy restoration of the animal by artificial respiration is that he was suffering more from the effect of asphyxia than from the effect of chloroform.

October 31st.—No. 41.

Temperature of the room 24 Cent. Full-sized, healthy pariah with a wound on the buttock. Placed in the chloroform box at 9 h. 48 m. Fell down 9 h. 52 m. 30 s. Taken out of box and placed on the table at 9 h. 56 m. Cornea insensitive 9 h. 57 m. Connexion made with manometer at 10 h. 21 m. Three Ludwig and one Fick tracings.

Trace I. Ludwig shows effect of—

H. M. S.

- A. 10 22 0.—Inhalation of chloroform with Junker, squeezed 40 times a minute, at the commencement of which there was a striking but temporary fall of pressure such as often accompanies the struggling and holding breath that ensue when the first whiffs of concentrated vapour are taken into the air-passages. This fall shows that the Junker apparatus interferes with the breathing.
- B. 10 30 10.—Inhalation of ammonia.
- C. 10 31 30.—Evulsion of toe-nails.
- D. 10 33 0.—Extraction of teeth.
- E. 10 40 30.—Irritation of nostril.

Trace II. Ludwig shows effects of—

H. M. S.

- F. 10 53 5.—Junker inhalation at the rate of 20 squeezes a minute.
- G. 10 56 0.—Catching hold and snipping off a piece of the skin of the anus.
- H. 10 57 30.—Pushing chloroform after respiration has stopped, and then artificial respiration.
- I. 11 2 0.—Ligature of the right vagus.
- J. 11 4 0.—Repetition of 3 and 4 and irritation of the central end of the cut vagus after the respiration had stopped.

Trace III. Ludwig shows effects of—

H. M. S.

- K. 11 20 0.—Junker administration with 10 squeezes per minute.
- L. 11 22 30.—Irritation of central end of right vagus when dog "well under," but not in danger.
- M. 11 44 0.—Artificial respiration, delayed for nearly a minute after spontaneous respiration had ceased.
- N. 11 50 0.—Hæmorrhage to 8 oz. from the femoral artery.
- O. 11 55 0.—Continued administration of chloroform by Junker at 10 squeezes per minute.

A clot having been found, the experiment was closed by squeezing the Junker apparatus rapidly 80 times a minute. The heart-beat (indicated by a flag thrust into the heart) continued six minutes after the respiration had entirely ceased and 3 m. 15 s. after the pulse was imperceptible.

The one Fick tracing includes 7 readings taken at periods indicated on the third Ludwig tracing.

November 1st.—No. 42.

Temperature of the room 22½ Cent. Full-sized healthy pariah. Chloroformed and placed on the table at 8 h. 18 m. 20 s. Hæmorrhage from the mouth while in the box about 1½ oz., the result of violent strangulation in restraining his movements. Kept quiet with chloroform as before. Struggled violently while taking some chloroform, and in consequence was given an overdose. Artificial respiration was

esorted to at 8 h. 22 m. 50 s., and was continued till 8 h. 34 m., but the dog did not recover. Post-mortem: Base of the left lung engorged; both sides of the heart very much distended with venous blood; valves healthy.

This dog's death was undoubtedly the result of the reckless carelessness which had marked the proceedings from the commencement, and was due quite as much to asphyxia as to chloroform.

November 1st.—No. 43.

Temperature of the room 23½ Cent. Full-sized healthy pariah. Chloroformed in the box as before. Placed on the table at 10 h. 5 m. and kept quiet, breathing stopped at 10 h. 13 m. 30 s. Artificial respiration until 10 h. 14 m. 30 s. Carotid ligatured at 10 h. 17 m. 30 s. Canula inserted into the carotid at 10 h. 20 m. Connexion made with the manometer at 10 h. 25 m. Two Ludwig and one Fick tracings.

Observations.

- H. M. S.
A. 10 25 0.—Administration of chloroform with Junker squeezed 10 times a minute, using the ordinary mouth-piece.
B. 10 30 20.—Administration of chloroform with the lead tube of the Junker thrust into the nostril in place of the mouth-piece, at first at the rate of 10 squeezes per minute, afterwards 20.
C. 10 35 0.—Squirting a few minims of chloroform into the nostril.
D. 10 44 20.—Administration of ether with a bladder, air being admitted through a side opening every five seconds (the ether administered in this way failed to keep the dog in a state of anaesthesia).

Trace II. Ludwig shows effects of—

- H. M. S.
E. 10 52 0.—Junker inhalation, with mouth-piece at 10 squeezes a minute.
F. 11 5 30.—Rapid administration of chloroform with Junker as is done frequently in hospitals, without attending to the signs of danger, while the operation for phymosis was being performed. The dog was dead after 10 minutes, very nearly four drachms of chloroform being used.

November 1st.—No. 44.

Temperature of the room 25½ Cent. Full-sized well-developed pariah dog. Into chloroform at 2 h. 1 m. Taken down at 2 h. 11 m. Put on dog board 2 h. 11 m. 30 s. and kept under chloroform as before. Ligature of the carotid at 2 h. 17 m. 40 s. Connexion made with manometer at 2 h. 26 m. 40 s. Three Ludwig tracings and two Fick. Trace I. Ludwig shows effects of administration of ether with a bladder, air being admitted through a side opening every ten seconds (This failed to keep the animal under.) Trace II. Ludwig shows effects of administration of ether with Junker's inhaler provided with a close fitting mouth-piece and also the effect of rapid hæmorrhage to 12 oz., from the femoral artery. Trace III. shows continued ether administration with Junker, and lastly death by pushing chloroform. Fick readings:—

- (1) Natural.
- (2) During ether administration with bladder.
- (3) Do. do. do.
- (4) Do. do. do.
- (5) Ether with Junker's inhaler; animal "over."
- (6) Ether immediately after 12 oz. hæmorrhage.
- (7) Same as 5; but a little later the effect of the hæmorrhage still marked.
- (8) The same; only more under the influence of ether.
- (9) Just after ether was stopped.
- (10) Effect of chloroform pushed.
- (11) Do. do.
- (12) Do. respiration stopped.
- (13) The animal dying.
- (14) Dead.

In this experiment (44) the figures (1), (2), (3), &c., refer to the Fick readings.

November 2nd.—No. 45.

Temperature of the room 23 Cent. Full-sized healthy pariah dog. Chloroformed at 9 h. 52 m. 45 s. Fell down at 9 h. 58 m. 15 s. Put on the table at 10 h. 1 m. 25 s. Kept quiet under chloroform. Respiration stopped and artificial respiration at 10 h. 15 m. Breathing spontaneously at 10 h. 15 m. 40 s. Carotid artery ligatured at 10 h. 18 m. 55 s. Respiration stopped at 10 h. 22 m. 5 s. Artificial respiration until 10 h. 23 m. 55 s. Connexion made with manometer at 10 h. 29 m. 30 s. Three Ludwig and three Fick tracings. During trace I. Ludwig ether was administered with bladder inhaler and a closely fitting mouth-piece, air being admitted every fifth and afterwards every tenth respiration, but this failed to keep the dog in a state of anaesthesia. Trace II shows administration of A.C.E. mixture by a Junker's inhaler, 10 squeezes per minute at first, then 20 squeezes, and finally with rapid squeezes. Trace III. shows the death of the dog, the blood-pressure remaining at 32 mm. The three Fick tracings give 15 readings at times marked upon the Ludwig tracings. Total A.C.E. mixture used, 9 drachms.

November 2nd.—No. 46.

Temperature of the room 25 Cent. Full-sized healthy pariah. Chloroformed in box at 2 h. 12 m. 10 s. Placed on the table at 2 h. 26 m. 30 s. and kept quiet with chloroform. Artificial respiration 2 h. 23 m. 30 s. to 2 h. 30 m. 50 s. Artery ligatured 2 h. 38 m. 55 s. Artificial respiration again 2 h. 42 m. to 2 h. 42 m. 20 s. Connexion made with manometers at 2 h. 46 m. 30 s. when the dog was just coming out of chloroform. Two Ludwig and three Fick tracings. Trace I. Ludwig was taken during the administration of A. C. E. mixture with Junker's inhaler, at first at the rate of 10 squeezes a minute, afterwards rapidly. During trace II. Ludwig the A. C. E. administration was continued, but as the effect was not sufficient, the bottle was filled up to 2 oz. with fresh A. C. E., after which the dog died rapidly. The three Fick tracings include 8 readings taken at times noted on the Ludwig tracings. Total A. C. E. mixture used, 13½ drachms.

November 2nd.—No. 47.

Temperature of room 25½ Cent. Full-sized healthy pariah, to whom ½ a grain of morphine had been given hypodermically about ½ an hour before. Given A. C. E. mixture on a cap 3 h. 43 m. Canula inseusible

3 h. 44 m. and placed on the table; quite under. Canula inserted into carotid 3 h. 53 m. Cornea sensitive and gave more A. C. E. at 3 h. 56 m. A. C. E. stopped again 3 h. 57 m. 45 s. Connexion made with manometer 3 h. 57 m. One Ludwig and one Fick trace showing the effect of killing the animal with A. C. E. on a cap. The quantity of A. C. E. used was not measured.

November 4th.—No. 48.

Temperature of room 21 Cent. Unusually large strong pariah dog, which had been fed habitually in the hospital. Chloroformed in the box at 7 h. 22 m. Put on the table and cornea insensible at 7 h. 44 m. 10 s. Artery ligatured 7 h. 56 m. 50 s. Canula inserted into carotid at 8 h. 7 m. 15 s. Connexion made with manometers at 8 h. 34 m. One Ludwig and one Fick tracings showing the effect of pushing chloroform with the ordinary cap. Recovery appeared for a few seconds to have been effected by artificial respiration, but he again ceased breathing and died. Post-mortem—More fat than usual throughout the whole body. A small cyst in the walls of the œsophagus. Heart healthy.

November 4th.—No. 49.

Temperature of room 23 Cent. Small-sized healthy pariah dog. Into chloroform box at 9 h. 44 m. 40 s. Placed on the table at 10 h. and kept quiet with chloroform. Carotid ligatured at 10 h. 9 m. Connexion with manometers at 10 h. 20 m. Three Ludwig and four Fick tracings. Trace I. Ludwig shows effect of pushing first chloroform, then ether, and lastly A. C. E., and reviving the dog each time with artificial respiration. Traces II. and III. show a repetition of the above (administration of chloroform, ether, and A. C. E.) and finally death from chloroform. The four Fick tracings include 25 readings at times noted on the Ludwig tracings.

Observations.

- H. M. S.
A. 10 20 30.—Chloroform on cap.
B. 10 25 0.—Respiration stopped and immediately afterwards the heart's action was arrested. This is what is called secondary syncope. It is not however syncope at all, but is inhibition of the heart due to vagus stimulation, and is a safeguard in that it delays the conveyance of the chloroform to the nerve centres. (Vide Fick 2 and compare with Fick 8.)
C. 10 25 10.—Artificial respiration showing the easy restoration of the animal.
D. 10 30 20.—Ether on cap.
E. 10 33 35.—Respiration stopped.
F. 10 33 50.—Artificial respiration and gradual restoration.
G. 10 38 50.—A. C. E. mixture on cap. This observation shows that chloroform, ether, and the A. C. E. Mixture produce precisely similar effects, only varying in intensity.
H. 10 41 30.—Respiration stopped. The same arrest of the heart's action subsequently took place as in observation C. Compare Fick 8 and 9 with Fick 2 and 3.
I. 10 42 0.—Artificial respiration and gradual restoration.
J. 10 49 45.—Observation B repeated. The record is incomplete on account of an interruption from clot.
K. 11 5 0.—Ether, with very little air, on cap. Respiration stopped at 11 h. 9 m. 30 s. Artificial respiration 11 h. 10 m. 6 s. restored the animal.
L. 11 27 0.—A. C. E. mixture on cap pushed till stoppage of the respiration. Restoration by artificial respiration.
M. 11 39 45.—Chloroform on cap pushed till death.

November 4th.—No. 50.

Temperature of room 25 Cent. Strong mongrel. Into chloroform box at 2 h. 27 m. 50 s. Placed on the table struggling violently at 2 h. 38 m., and was given chloroform on a cap. Stopped breathing at 2 h. 39 m. 50 s. Artificial respiration was at once begun and the animal breathed spontaneously at 2 h. 42 m. Artificial respiration was again necessary almost immediately, and failed to restore natural respiration. Post-mortem showed that the abdominal cavity was full of blood from rupture of the liver. The pericardium was adherent; valves healthy. Small abscesses in spleen and liver. This death was the result of excessive zeal and energy in the performance of artificial respiration.

November 4th.—No. 51.

Temperature of room 25 Cent. Full-sized, fairly nourished pariah. Put into chloroform box at 2 h. 50 m. 55 s. Fell down at 2 h. 55 m. Placed on the dog-board at 2 h. 58 m. 15 s. Artery ligatured at 3 h. 5 m. 30 s. Connexion made with the manometers at 3 h. 12 m. 40 s. One Ludwig and one Fick tracing. The Ludwig tracing shows (a) the depressing effect of thrusting a needle into the heart; (b) a slighter but distinct depression while struggling at the commencement of ether administration; (c) death from ether when pushed with an ordinary cap covered with Mackintosh. The Fick tracing includes seven distinct readings at times noted in the Ludwig trace. The readings along the top of the Fick tracing were produced by a system of Marey's tambours connected with a needle in the heart. Post-mortem—Heart healthy; liver ruptured, but only a small quantity of blood in the abdomen.

- H. M. S.
A. 3 13 30.—Needle thrust into the heart.
B. 3 16 0.—Ether administered; the effect of struggling caused slowing of the heart, exactly in the same way as it does under chloroform, and is well shown in Fick I.
C. 3 22 50.—Respiration stopped.
D. 3 23 20.—Artificial respiration; death.

November 4th.—No. 52.

Temperature of room 25½ Cent. Full-sized strong pariah. Put into the chloroform box at 3 h. 38 m. Fallen down at 3 h. 40 m. 50 s. Placed on the table at 3 h. 42 m. 45 s. and kept quiet with chloroform. Carotid artery ligatured 3 h. 49 m. 50 s. Canula inserted 3 h. 58 m. 40 s. Connexion made with manometers at 4 h. One Ludwig and two Fick tracings during—

- (1) Administration of A.C.E. with marked but intermittent falls in the blood-pressure during struggling.
- (2) Pushing A.C.E. until respiration stopped.
- (3) Artificial respiration.
- (4) Thrusting a needle into the heart.
- (5) Pushing A.C.E. until death resulted.

Post-mortem.—Organs healthy. Above two drachms of blood in the pericardium.

Observations.

- H. M. S.
A. 4 3 0.—A.C.E. mixture: struggling, and consequent irregularities in the fall of blood-pressure of precisely the same kind as those which occur under similar circumstances with chloroform and with ether: a needle was thrust into the heart twice during the observation. The A.C.E. mixture was pushed till stoppage of the respiration at 4 h. 5 m. 0 s. A needle was thrust into the heart again at 4 h. 9 m. 20 s. during revival; and the depressing effect of this operation is well shown in the tracing.
- B. 4 11 30.—A.C.E. mixture pushed till respiration stopped: death. In Experiment 52 the effect on the heart of holding the breath is very frequently demonstrated in the Ludwig tracing from 4 h. 11 m. 35 s. to 4 h. 12 m. 0 s. and in the Fick I. tracing 4.

November 5th.—No. 53.

Temperature of the room 23 Cent. Full-sized pariah dog. Into chloroform box at 7 h. 47 m. 20 s. Fallen down at 7 h. 57 m. Placed on the table at 8 h. 2 m. 15 s. Artery ligatured at 8 h. 17 m. 20 s. Canula inserted at 8 h. 23 m. 30 s. Connexion made with manometers at 8 h. 27 m. 30 s. Two Ludwig and two Fick tracings. The tracings show the effect of pushing first chloroform and afterwards ether administered on an impervious cap, and finally killing with chloroform. They also show the effect of thrusting a needle into the heart, and the continued irritation caused by its presence. *Post-mortem*—Three drachms of blood in the pericardium. Mitral valves a little thickened. Apex of right ventricle attenuated.

Observations.

- H. M. S.
A. 8 27 30.—Needle into heart.
- B. 8 30 40.—Chloroform pushed till stoppage of the respiration: revival by artificial respiration.
- C. 8 38 0.—Needle thrust into the heart.
- D. 8 41 0.—Ether administered; struggling and similar irregularities in the circulation, as are observed during struggling under chloroform and the A.C.E. mixture.
- E. 9 23 35.—Chloroform pushed: the respiration stopped at 9 h. 24 m. 30 s. The heart continued to beat till 9 h. 32 m. 20 s.

November 5th.—No. 54.

Temperature of the room 24 Cent. Full-sized pariah dog. Chloroformed in box 10 h. 9 m. 15 s. Dog fallen down 10 h. 14 m. 20 s. Placed on the table 10 h. 15 m. 25 s. Stopped breathing 10 h. 16 m. 10 s. Artificial respiration tried without effect. *Post-mortem*—Organs healthy; two ribs fractured. In this case there was no doubt that chloroform had been carelessly administered while the operation for tying the carotid was being performed.

November 5th.—No. 55.

Temperature of the room 24 Cent. Full-sized pariah dog. Put into the chloroform box at 10 h. 29 m. 25 s. Placed on the table at 10 h. 42 m. 30 s. Artery ligatured at 10 h. 51 m. 30 s. Connexion made with the manometers at 10 h. 56 m. 10 s. One Ludwig and one Fick tracing showing administration of ether without air, its failure to keep the dog under and finally death from pushing A. C. E. *Post-mortem*—Two ounces of arterial blood in pericardium. The needle had passed through the lungs into the left auricle. (In this as in previous cases the upper line on the Fick tracing is produced by a system of Marey's tambours connected with the needle in the heart.)

- H. M. S.
A. 10 57 0.—Needle thrust into heart. The depressing effect of this measure is shown in Fick reading 1.
- B. 11 0 25.—Ether with the air excluded.
- C. 11 21 20.—A.C.E. mixture pushed till death.

November 5th.—No. 56.

Temperature of the room 25 Cent. Full-sized strong pariah. Chloroform given at 1 h. 48 m. 30 s. Fallen down at 1 h. 56 m. 30 s. Placed on the table at 1 h. 58 m. 10 s. Artery ligatured at 2 h. 6 m. 45 s. Canula inserted at 2 h. 11 m. 30 s. Connexion with manometers at 2 h. 15 m. 15 s. In this experiment it was intended to smother the dog with a tin mouth-piece carefully closed, but after death it was found that a sponge with a small amount of chloroform upon it had been accidentally left inside the mouth-piece. One Ludwig and one Fick tracing showing—

Observations.

- H. M. S.
A. 2 16 20.—Chloroform; stopped at 2 h. 17 m. 40 s., needle into the heart at 2 h. 17 m. 50 s.
- B. 2 20 5.—Simple asphyxia with a very small quantity of chloroform, accidentally left in the inhaler. At 2 h. 27 m. 0 s. the heart's action was arrested, probably owing to vagus stimulation, for 15 seconds (*vide* Fick 7). The heart stopped finally at 2 h. 30 m. 0 s.

Fick reading 8 shows clearly the gradual cessation of movement in the needle thrust into the heart. *Post-mortem* examination showed general venous congestion; small hamorrhage in the lungs; a small cyst in the wall of the heart, and a large suppurating lymphatic gland in the wall of œsophagus.

November 5th.—No. 57.

Temperature of room 26 Cent. Full-sized pariah. Chloroformed in box 2 h. 37 m. 15 s. On the table 2 h. 42 m. 30 s. Artery ligatured 2 h. 49 m. Connexion made with manometer 2 h. 53 m. One Ludwig and two Fick tracings. An attempt was made to simply smother the dog with the padded mouth-piece; but complete asphyxia could not be produced, and he was eventually killed with A.C.E. mixture pumped into the mouth-piece with Junker's inhaler. Fick readings 4, 6, and 7 show very well the slowing of the heart produced by asphyxia. *Post-mortem*—Intense venous congestion.

Observations.

- H. M. S.
A. 2 53 40.—Partial asphyxia.
- B. 3 11 5.—A.C.E. mixture pumped into the mouth-piece with Junker's inhaler till death. Respiration ceased at 3 h. 16 m. 0 s. and the heart stopped at 3 h. 20 m. 15 s.

November 5th.—No. 58.

Temperature of the room 26 Cent. Full-sized powerful pariah dog. Into the chloroform box at 3 h. 23 m. 15 s. Fallen down at 3 h. 32 m. 10 s. Placed on the table at 3 h. 33 m. 45 s. and kept quiet with chloroform. Artery ligatured at 3 h. 40 m. Canula inserted at 3 h. 45 m. 30 s. Connexion made with manometers at 3 h. 44 m. 35 s. One Ludwig and one Fick tracing. Asphyxia by means of the mouth-piece was again attempted, but as this failed to kill the dog owing to leaks, chloroform vapour was pumped into the closed mouth-piece with Junker. Unfortunately directly after this a clot formed in the tube.

November 6th.—No. 59.

Temperature of room 22.5 Cent. Full-sized pariah. Into chloroform box at 8 h. 20 s. Fell down at 8 h. 9 m. 45 s. Placed on the table at 8 h. 10 m. Temperature in rectum 100.4 F. More chloroform at 8 h. 17 m. 35 s. and again at 8 h. 23 m. 30 s. Canula inserted at 8 h. 26 m. 30 s. Connexion made with the manometers at 8 h. 32 m. 20 s. One Ludwig and two Fick tracings showing the effect of asphyxiating the animal by holding a carefully-sealed inhaler over his muzzle. The act of thrusting the needle into the heart did not cause any fall of pressure. Temperature in the rectum 99 F. at the end of experiment. *Post-mortem* presented all the appearance of asphyxia. The needle had entered the heart through the auriculo-ventricular groove and just reached the interior behind one of the semi-lunar valves. No blood in the pericardium.

November 6th.—No. 60.

Temperature of room 23 Cent. Large size dog. Into chloroform box at 10 h. 3 m. Fell down at 10 h. 12 m. Placed on the table at 10 h. 13 m. Temperature in the rectum 100.4 F. A little chloroform given at 10 h. 21 m. Artery ligatured at 10 h. 22 m. 10 s. Canula inserted at 10 h. 25 m. Connexion made with manometer at 10 h. 27 m. One Ludwig and one Fick tracings. Asphyxia was first produced by smothering the dog with an empty inhaler, and then chloroform was pumped into the still air-tight inhaler. Death resulted very rapidly. From Fick reading 3 it was thought that the heart had stopped simultaneously with the respiration, but on opening the thorax, the heart was found to be still beating, and it continued to do so for some minutes. *Post-mortem* appearances those of chloroform poisoning. Temperature after the experiment 99 F.

Observations.

- H. M. S.
A. 10 28 0.—Smothering with an empty inhaler. The irregular fall of pressure due to asphyxia, and to asphyxia combined with chloroform, is seen in Fick readings 1 and 2.
- B. 10 32 5.—Chloroform pumped into the air-tight inhaler. Fick 3 shows the very rapid fall of pressure due to vagus stimulation in an animal already partially asphyxiated, and how quickly chloroform poisoning and paralysis of the respiratory centre occurs under these circumstances. From Fick 3 and the absence of pulse it was thought by everybody present that the heart had altogether stopped, simultaneously with the respiration, at 10 h. 35 m. 0 s., but when the thorax was opened at 10 h. 36 m. 30 s., three minutes and a-half after the breathing stopped, the heart was found to be beating vigorously, and it continued to do so till 10 h. 39 m. 50 s., nearly seven minutes after the cessation of respiration.

Experiment No. 60 affords an excellent example of the remarkable slowing and even temporary cessation of the heart's action, which occurred again and again throughout the Commission's enquiry at the same moment as the respiration stopped. The heart always recovered itself and began to beat regularly again before any steps were taken to restore the animal and without any respiration taking place. (*Vide* Experiments Nos. 49, 162 and 178, and compare with 60.) The failure of the heart, if such it can be called, instead of being a danger to the animal, is a safeguard by preventing the absorption of residual chloroform from the lungs and its distribution through the system. If the arrest of the heart in these experiments is due, as it appears to be, to vagus stimulation, there is no doubt that the inhibiting action benefits the organ and, besides resting it, acts on it as a tonic.

November 6th.—No. 61.

Temperature of room 24 Cent. Full-sized pariah dog. Put into the chloroform box at 10 h. 42 m. Fallen down at 10 h. 55 m. 30 s. Placed on the table at 10 h. 57 m. 45 s. Temperature in the rectum 99.2 F. Artery ligatured at 11 h. 4 m. A little chloroform given at 11 h. 9 m. Connexion made with the manometers at 11 h. 10 m. 15 s. Temperature after death 98.2 F. Two Ludwig and two Fick tracings showed the effect of giving ether to an asphyxiated animal. The extraordinary fall of pressure, which occurred at the commencement of the ether inhalation, is noticeable. It was the accompaniment probably of struggles and holding breath, though this was not noted on the tracing. As ether did not appear to be going to kill the animal in a reasonable time, chloroform was pumped into the inhaler, and death ensued rapidly. The second Ludwig tracing is imperfect, on account of the float not working freely in the tube of the manometer. The needle was found in the apex of the left ventricle.

November 6th.—No. 62.

Temperature of the room 25.5 Cent. Full-sized strong pariah dog. Put into chloroform box at 2 h. 25 m. Fallen down at 2 h. 32 m. 30 s. Put on the table at 2 h. 34 m. 30 s. Temperature in the rectum 101 F. Artery ligatured at 2 h. 40 m. 30 s. Canula inserted into the carotid at 2 h. 44 m. Connexion made with the manometers at 2 h. 46 m. One Ludwig and one Fick tracing. A little chloroform was given at first to quiet the animal and diminish the excursions of the needle. Afterwards the empty inhaler was applied and made as air-tight as possible, and, lastly, A. C. E. was pumped into the inhaler until death ensued.

The end of the experiment was interrupted by a clot. Temperature in the rectum 99 F. after the experiment.

November 6th.—No. 63.

Temperature of the room 25.5 Cent. Medium-sized strong pariah dog. Put into the box and chloroform given at 3 h. 19 m. 10 s. Fallen down at 3 h. 30 m. 15 s. Brought on to the table at 3 h. 31 m. 15 s. Temperature in the rectum 101.6 F. Chloroform from time to time to keep him quiet. Artery ligatured at 3 h. 41 m. 25 s. Canula inserted into carotid at 3 h. 42 m. 50 s. Glass tube tied into the trachea at 3 h. 50 m. Connexion made with the manometers at 3 h. 53 m.

One Ludwig and one Fick tracing, showing the effect of opening and closing the tracheal tube (*vide* especially Fick readings 3 and 4). Chloroform was afterwards pumped into the tracheal tube by means of Junker's inhaler until death ensued.

November 7th.—No. 64.

Temperature of the room 21 Cent. Full-sized pariah dog, rather thin. Put into the chloroform box at 7 h. 46 m. 30 s. Fallen down at 7 h. 52 m. 30 s. Placed on the table at 7 h. 53 m. and given a little chloroform from time to time to keep him quiet. Artery ligatured at 8 h. 5 m. 10 s. Temperature in the rectum 98.2 F. A loose ligature placed under both vagi. Connexion made with the manometer at 8 h. 20 m. 15 s. Three Ludwig and three Fick tracings. Ludwig I. is during (a) a short administration of chloroform; (b) ligature of the right vagus after the chloroform was stopped, causing very marked and continued depression; (c) artificial respiration; (d) division of the right vagus; (e) peripheral irritation of the right vagus, electrically (coils distant 10 cent.), with at the same time the pushing of chloroform on an ordinary cap for a little over two minutes; (f) artificial respiration and gradual recovery. Ludwig tracing II. is during (g) peripheral irritation of the right vagus (Fick reading 9); (h) irritation of right vagus, peripheral as before, and pushing of chloroform at the same time (Fick reading 11.) for about one minute; (i) gradual recovery without artificial respiration; (j) the same experiment again, irritation of right vagus and pushing chloroform for over two minutes; (k) recovery again without artificial respiration, but in the course of recovery, irritation of the right central vagus; and (l) ligature and section of the left vagus. Ludwig tracing III. is during (m) irritation of the periphery of both vagi with pushing of chloroform at the same time for about two minutes; (n) opening and placing a tube into the trachea; (o) chloroform accidentally squirted into the trachea and gradual death of the animal. The time of the 22 Fick readings is noted on the Ludwig tracings. Temperature in the rectum after death 98.4 F.

Observations.

- H. M. S.
- A. 8 20 30.—Chloroform administered. Irritation of right vagus at 8 h. 22 m. 0 s., causing almost total arrest of the pulse from 8 h. 22 m. 0 s. to 8 h. 23 m. 45 s. During this period there were only 25 pulsations registered, and most of these pulsations occurred during the last 45 seconds (*vide* Fick 2). Chloroform was pushed to stoppage of the respiration and the animal was restored by artificial respiration. The vagus was divided at 8 h. 27 m. 0 s.
- B. 8 29 50.—Irritation of the peripheral end of the right vagus when the animal was out of chloroform. The slowing of the heart and great fall of blood pressure caused by stimulation of the vagus are well shown on the Ludwig tracing. The administration of chloroform was commenced during more or less complete inhibition of the heart (*vide* Fick 5 and 6) from 8 h. 30 m. 10 s. to 8 h. 32 m. 0 s. The respiration ceased at 8 h. 32 m. 0 s. and the chloroform cap was removed. Artificial respiration was not begun until 8 h. 33 m. 55 s. and natural breathing was restored at 8 h. 39 m. 0 s.
- C. 8 53 30.—Irritation of peripheral end of right vagus followed by rapid chloroform administration at 8 h. 53 m. 40 s. (*vide* Fick 11). At 8 h. 54 m. 15 s. the vagus irritation was stopped, and the administration of chloroform was discontinued at 8 h. 54 m. 30 s. At 9 h. 1 m. 30 s., when the animal was coming round spontaneously, irritation of the peripheral end of the right vagus was again commenced, while chloroform was pushed simultaneously and continued until 9 h. 3 m. 40 s. The respiration entirely ceased at 9 h. 3 m. 10 s., and recommenced spontaneously at 9 h. 4 m. 10 s. The chloroform cap was removed, but the blood-pressure continued to fall, owing to the residual chloroform in the lungs, until 9 h. 4 m. 40 s. (*vide* Fick 13). The central end of the right vagus was irritated from 9 h. 6 m. 55 s. until 9 h. 7 m. 50 s., and this caused *very slow respiration*. The left vagus was divided at 9 h. 9 m. 40 s.
- D. 9 14 20.—Electrical irritation of peripheral ends of both vagi, causing an immediate fall of the blood-pressure almost to zero. Chloroform administration was pushed during complete inhibition of the heart's action at 9 h. 14 m. 30 s. There was entire absence of pulse-tracing for more than one and a half minutes, the blood-pressure remained nearly at zero, and the breathing became slow. The irritation and the administration of chloroform were both stopped at 9 h. 16 m. 0 s. The blood-pressure rose immediately to nearly its former height. It then gradually fell, exactly as it does in chloroform administration with normal breathing, and rose again spontaneously at the end of one minute. The fall of pressure after the cessation of vagus stimulation constitutes the most interesting phenomenon in this observation. From 9 h. 14 m. 20 s. to 9 h. 16 m. 0 s. cardiac inhibition, with sudden and prolonged fall of blood-pressure, was caused by stimulation of the vagi. The arrest of

the circulation, due to stoppage of the heart, prevented the chloroform, which from 9 h. 14 m. 30 s. was saturating the air deep down in the lungs, from getting into the blood. But when the circulation was resumed at 9 h. 16 m. 0 s. the chloroform was forthwith taken up by the blood, and the respiration was no longer a factor in the process, except to eliminate it from the lungs. The effect of the uncontrollable absorption of chloroform into the blood was, not to give rise to any paralysis or weakening of the heart, but simply to produce the ordinary regular and gradual fall of the blood-pressure, which is associated with narcosis of the nerve centres in the medulla, in normal chloroform inhalation. The trachea was opened at 9 h. 19 m. 0 s. and a tube inserted at 9 h. 19 m. 50 s.

B. 9 25 0.—Chloroform was accidentally squirted into the trachea. Respiration stopped at 9 h. 28 m. 45 s.; slight thoracic movements occurred at 9 h. 31 m. 25 s.; a needle was inserted into the heart at 9 h. 33 m. 30 s.; and the heart-movements were perceptible until 9 h. 35 m. 20 s. The artery was cut and the pressure fell to zero at 9 h. 36 m. 0 s.

November 7th.—No. 65.

Temperature of the room 23.5 Cent. Full-sized pariah, but very old. Put into the chloroform box at 10 h. 43 m. 30 s. The dog escaped from the box, but was put into it again at 10 h. 45 m. 15 s. Fallen down at 10 h. 56 m. Placed on the table at 10 h. 56 m. 45 s. and given enough chloroform from time to time to keep him quiet. Temperature in the rectum 100.8 F. at 11 h. 4 m. 20 s. Artery ligatured at 11 h. 7 m. Canula inserted into the artery at 11 h. 6 m. Loose ligature placed under both vagi. Connexion made with manometers at 11 h. 20 m. 5 s. Three Ludwig and three Fick tracings during (a) rapid chloroform administration until respiration ceased and for about a quarter of a minute afterwards, i.e., for 1 minute in all; (b) gradual recovery without artificial respiration; (c) double ligature and division of the right vagus; (d) irritation of the peripheral end of the right vagus, together with pushing of chloroform by the ordinary cap for 2½ minutes. The distance of the coils was changed from 10 cents. to 5 cents. in the middle of the experiment; (e) gradual recovery without artificial respiration; (f) irritation of the central end of the right vagus (Fick reading 7); (g) pushing chloroform for nearly one minute and stopping the respiration, necessitating resort to (h) artificial respiration; (i) irritation of the central end of the right vagus again (Fick 10); (j) irritation of the periphery of the vagus again with chloroform pushed as before for five minutes; (k) spontaneous tendency to recovery assisted after 3½ minutes by a short artificial respiration; (l) ligature and division of left vagus; (m) pulling at the vagi; (n) irritation of both vagi, pushing chloroform for just over 5 minutes, while artificial respiration was employed whenever the respiration stopped so as to ensure the chloroform entering the lungs. Afterwards the dog took a few shallow respirations and then died in spite of artificial respiration.

Temperature in the rectum just after death 98 F.

Observations.

- H. M. S.
- A. 11 22 50.—Pushed chloroform; breathing stopped at 11 h. 23 m. 34 s.; chloroform cap removed 11 h. 23 m. 50 s.; breathing restored spontaneously without artificial respiration.
- B. 11 30 0.—Chloroform pushed with simultaneous irritation of peripheral end of right vagus. The slowing of the pulse due to vagus stimulation is shown in Fick 4. Breathing stopped at 11 h. 32 m. 35 s., and recommenced spontaneously at 11 h. 33 m. 20 s. Fick 7 shows the tracing of the respiration and pulse during irritation of the central end of the vagus. The respiration was not stimulated, but arrested by the irritation of this portion of the nerve.
- C. 11 38 5.—Chloroform pushed till 11 h. 38 m. 55 s., when the respiration stopped and the pulse tracing disappeared (*vide* Fick 8). The animal was restored by artificial respiration. The central end of the right vagus was irritated from 11 h. 41 m. 50 s. to 11 h. 42 m. 20 s. The effect in slowing the respiration, and of this on the pulse, is well shown in Fick 10.
- D. 11 51 55.—Irritation of the peripheral end of right vagus followed at 11 h. 52 m. 0 s. by chloroform. The irritation and chloroform were kept up till 11 h. 57 m. 0 s. Respiration stopped at 11 h. 54 m. 0 s. There were a few gasps at 11 h. 57 m. 10 s. Artificial respiration was not commenced till 12 h. 0 m. 40 s. The animal recovered. The first respirations are seen in the Ludwig tracing between 12 h. 1 m. 0 s. and 12 h. 2 m. 0 s. The effects of stimulation of the vagus in slowing the heart and circulation are displayed in readings 13, 14, 15, 16, and 17 Fick. The left vagus was divided at 12 h. 4 m. 45 s.
- E. 12 12 45.—Irritation of the peripheral ends of both vagi and chloroform administration kept up till 12 h. 18 m. 0 s., the chloroform being inhaled by artificial respiration when natural respiration failed. Death ensued. Experiment No. 65 proves that inhibition of the heart's action, due to stimulation of the vagi during continued chloroform administration, prevents rather than assists the fatal effects of prolonged chloroform inhalation, and that lowering of the blood-pressure either suddenly or gradually without weakening of the heart is in no sense a danger.

November 8th.—No. 66.

Temperature of the room 21.5 Cent. Full-sized pariah dog. Into chloroform box at 9 h. 25 m. 30 s. Fallen down at 9 h. 33 m. Placed on

the table at 9 h. 35 m. 45 s., and given chloroform now and again. Canula inserted into left carotid. Loose ligatures placed under both vagi and a large-sized glass tube tied into the trachea. Connexion made with the manometers at 10 h. 6 m. The animal was first asphyxiated and then given ether through the tracheal tube by means of Junker's inhaler. Death ensued rapidly.

November 8th.—No. 67.

Temperature of the room 23 Cent. Full-sized pariah dog. Into the chloroform box at 10 h. 39 m. 15 s. Fallen down at 10 h. 48 m. 0 s. Placed on the table at 10 h. 51 m. 30 s. Temperature in the rectum 99° 0 F. Ligature of the carotid at 11 h. 3 m. 30 s. Tube placed in trachea and loose ligatures under both vagi. Connexion made with manometers at 11 h. 16 m. One Ludwig trace and one Fick (one Fick reading is incorporated with the Fick readings of 68). Chloroform was administered by the Junker inhaler attached to the tracheal tube and death occurred very rapidly. Before the chloroform was given the sciatic nerve was irritated. Artificial respiration was tried for several minutes in vain, though it kept up a certain amount of blood-pressure, and ammonia was held opposite the opening of the trachea. Post-mortem examination showed that there was nothing abnormal in the heart or other organs. Rupture of the liver had occurred and there was much blood in the peritoneum, but this can only have occurred after the death of dog, as artificial respiration was very gently applied for a long time. Temperature in the rectum after death 99° 4 F.

November 8th.—No. 68.

Monkey (fair-sized Macacus). Chloroformed at 2 h. 10 m. 45 s. in box. Temperature of the room 24° 5 Cent. Fallen down at 2 h. 23 m. 15 s. On the table at 2 h. 27 m. 45 s. and kept quiet with chloroform from time to time. Temperature in rectum 100° 6 F. Carotid artery ligatured at 2 h. 38 m. Canula inserted at 3 h. 40 m. 30 s. Ligature placed under both vagi. Junker's lead tube inserted into an opening in the trachea and the chloroform administered through it. Connexion made with manometers at 3 h. 5 m. 30 s., but stopped again almost immediately on account of bleeding from the artery below the canula. Connexion again made at 3 h. 19 m. 15 s. One Ludwig and one Fick tracing. During the tracings numerous attempts were made to irritate the right vagus, but it is not probable that the nerve had really been exposed. The canula slipping at 3 h. 38 m., an attempt was made to place it in the right carotid, but failed, and the experiment was closed by killing the monkey with chloroform.

November 8th.—No. 69.

Temperature of room 25 Cent. Full-sized pariah dog just brought in. Into chloroform box at 4 h. 6 m. Fallen down at 4 h. 12 m. 20 s. Placed on the table at 4 h. 13 m. 30 s. Artery ligatured at 4 h. 18 m. 50 s. Breathing stopped at 4 h. 19 m. 40 s. Artificial respiration until 4 h. 20 m. 30 s. Temperature in rectum 103° 2 F. Connexion made with manometers at 4 h. 29 m. 30 s. Two Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 4 32 0.—Electrical irritation of the entire left vagus with the coils 5 cent. apart.
B. 4 33 0.—The same, Fick reading 2.
C. 4 35 10.—The same, only coils approach to 0. Fick 3.
D. 4 39 10.—The same.
E. 4 39 55.—Administration of chloroform, during which the right vagus was accidentally irritated in the process of exposing it.
F. 4 41 30.—Electrical irritation, coils 0, of the entire right vagus, the animal being nearly out of chloroform.
G. 4 42 10.—The same. Fick reading 6.
H. 4 50 0.—Exposure of the sciatic nerve.
I. 4 51 15.—Irritation of the right vagus as before, with simultaneous irritation of the sciatic nerve.
J. 4 54 0.—The same, Fick reading 7.
K. 4 54 30.—Ordinary administration of chloroform.
L. 5 1 0.—Repetition of I and K when the dog was "well under," *vide* Fick 9.
M. 5 5 0.—Administration of ether on a sponge placed in a tin inhaler with the air-holes open.
N. 5 9 0.—Repetition of I, K, and M, under ether.
O. 5 13 0.—The same. *Vide* Fick 11; the effect of irritating the vagus not marked as before.
P. 5 16 0.—Division of the right vagus.
Q. 5 20 0.—Irritation of the peripheral end of the right vagus while still under ether.
R. 5 21 0.—Ditto when dog "quite out." Chloroform was then pushed until death resulted, the heart stopping at 5 h. 25 m. But the tracing was interrupted by a clot in the tube.

November 9th.—No. 70.

Temperature of the room 20 Cent. Large-sized pariah dog. Into chloroform box at 9 h. 42 m. 50 s. Fallen down at 9 h. 45 m. 15 s. On the table at 9 h. 47 m. Left carotid artery ligatured at 9 h. 53 m. 15 s. and canula inserted into it. Loose ligature under right carotid and both vagi. Connexion made with manometers at 10 h. 2 m. 40 s. Two Ludwig and one Fick tracings.

Observations.

- H. M. S.
A. 10 3 30.—Clamping the right carotid artery so that both carotids were obstructed.
B. 10 6 40.—Administration of ether in an open inhaler, through which there was free entrance of air during the clamping of the carotid and after the clamp was taken off.
C. 10 17 35.—Ligature and division of the right vagus.
D. 10 19 10.—Peripheral irritation of the right vagus with a 5 cent. coil. Cornua insensitive.
E. 10 20 15.—Repetition of D, *vide* Fick reading 7.
F. 10 22 0.—Exposing sciatic nerve.
G. 10 24 10.—Irritation of the sciatic nerve, coil 5. No effect.
H. 10 37 35.—Opening the trachea and fixing a tube in it.
I. 10 39 55.—Administration of ether on a blotting paper cone held over the end of the tracheal tube. This, however, failed to keep the dog insensitive, although a little ether was squeezed into the tube.

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- J. 10 48 40.—Continued ether administration with the end of the tube closed by compressing the cone and afterwards by squirting a little ether into the trachea.
K. 10 51 50.—Artificial respiration in vain.

Temperature after death 97° 6 F. Post-mortem—Blood on both sides of the heart; large plug of venous blood at the bifurcation of the trachea extending far down into the bronchi, probably the result of blood running into trachea, post mortem, when the tube was taken out, as this was observed to happen in No. 71 after the tube was taken out. The upper readings on the Fick manometer tracing were produced by a system of Marey's tambours connected with a pin stuck into the diaphragm.

November 9th.—No. 71.

Temperature of room 22° 5 Cent. Full-sized pariah. Weight 30 lb. Into box at 11 h. 2 m. 40 s. and chloroform commenced. Fallen down at 11 h. 6 m. 10 s. On table at 11 h. 9 m. 45 s. Kept quiet with chloroform. Respiration stopped at 11 h. 12 m. Artificial respiration directly this was observed and continued till 11 h. 12 m. 50 s., when spontaneous respiration recommenced. A good deal of hæmorrhage from vessels in the neck. Two veins and one small artery ligatured. Artery ligatured at 11 h. 25 m. Canula inserted at 11 h. 26 m. 30 s. into left carotid. Loops under both vagi, tie right carotid, and trachea. Temperature in rectum 99° 4 F. Connexion made with manometer at 11 h. 33 m. 55 s. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 11 35 40.—Clamping of the right carotid so as to close both carotid arteries.
B. 11 38 20.—Exposing the sciatic nerve.
C. 11 38 50.—Ordinary chloroform administration.
D. 11 40 40.—Irritation of the sciatic coil 5 when hardly under chloroform, which was being pushed.
E. 11 41 30.—Ligature and division of right vagus.
F. 11 47 10.—Irritation of sciatic again after administration of chloroform had ceased, but dog still under.
G. 11 47 30.—Irritation of the sciatic again, but in the middle increasing the strength by moving the coil to 0 (Fick reading 6). The irritation of the sciatic produced no effect.
H. 11 50 0.—Opening the trachea and placing a tube in it.
I. 11 52 0.—Giving chloroform on a cone of blotting-paper attached to the tracheal tube.
J. 12 0 40.—Administration of ether in the same way for a few seconds by mistake.
K. 12 4 0.—Pulling at the right vagus.
L. 12 4 50.—Irritation of the peripheral end of the right vagus, coil 5 during continued pushing of chloroform.
M. Irritation of both right vagus and sciatic during continued pushing of chloroform. Stoppage of the respiration at 12 h. 8 m. 0 s. and spontaneous recovery at 12 h. 9 m. 45 s.
N. 12 10 30.—Squirting a drachm of chloroform into the tracheal tube, and—
O. 12 11 30.—Irritation of the right vagus again. The end was obscured by a clot in the tubes.

Temperature at death 98 F.

November 9th.—No. 72.²

Temperature of the room 23° 5 Cent. Full-sized pariah dog. Weight 30 lbs. Into the chloroform box and chloroform given at 2 h. 21 m. 50 s. Placed on the table at 2 h. 25 m. 35 s. and kept quiet with chloroform. Stopped breathing at 2 h. 24 m. 15 s. Artificial respiration until 2 h. 35 m. 45 s. Temperature 108° 8 F. in the rectum. Left carotid ligatured at 2 h. 36 m. 45 s. Right jugular vein ligatured and canula inserted at 2 h. 52 m. Connexion made with the manometer at 2 h. 53 m. 30 s. One Ludwig and one Fick tracing showing the effect of injecting ether and afterwards chloroform into the jugular vein. Temperature after death 102° 2 F. Post-mortem—the blood in the left side of the heart was clotted.

Observations.

- H. M. S.
A. 2 58 45.—Fifteen minims of ether injected into the jugular vein: no appreciable effect. At 2 h. 59 m. 40 s. twenty minims of ether were again injected. Between 3 h. 1 m. 0 s. and 3 h. 1 m. 30 s. one drachm of ether was injected into the jugular vein and the blood-pressure fell very rapidly. The respiration stopped at 3 h. 2 m. 0 s., and the Fick reading 2 shows almost total arrest of the pulse tracing exactly similar to that caused by vagus stimulation after cessation of the respiration from chloroform poisoning. At 3 h. 2 m. 20 s. artificial respiration was commenced and natural respiration was restored at 3 h. 4 m. 30 s.
B. 3 8 30.—Twenty minims of chloroform injected into jugular vein. The effect was precisely the same as that of the intravenous injection of ether. Fick reading 4 with chloroform is identical with Fick reading 2 with ether. This and other experiments, when pure chloroform and ether were injected into the large veins of the neck, show that even pure chloroform or ether in the blood do not stop the heart till after they have produced narcosis and paralysed the respiration.

The most important point in Experiment 72 is that after a considerable amount of ether had been injected into the jugular vein and a rapid condition of pulse had been produced, the effect of injecting chloroform into the jugulars was much greater, and the fall of blood pressure was much more rapid and dangerous than in the case when chloroform alone was injected.

November 9th.—No. 73.⁴

Temperature of the room 24 Cent. Full-sized pariah. Weight 32 lbs. Put into chloroform box at 3 h. 28 m. Fallen down at 3 h. 35 m. 40 s.

² Nos. 72 and 73 may be grouped with Nos. 77, 91, 92 and 93.

⁴ *Ibid.*

Placed on the table at 3 h. 36 m. 30 s. Temperature 102.2 F. in rectum. Jugular vein ligatured and canula inserted. Left carotid ligatured at 3 h. 45 m. Connexion made with the manometers at 3 h. 50 m. One Ludwig and two Fick tracings during injection of ether (Fick 2) into jugular vein, afterwards chloroform (Fick 5) and again ether (Fick 9), which brought about death. Temperature after death 100 F. Post-mortem—Small clot in the left ventricle, which was filled with venous blood, clot in superior vena cava. Serous fluid in the pericardium.

Observations.

- H. M. S.
A. 3 53 10.—Injection of twenty minims of ether into deep jugular vein; repeated at 3 h. 53 m. 35 s., 3 h. 54 m. 5 s., and 3 h. 54 m. 30 s. The effect is shown in Fick reading 2.
B. 3 59 40.—Injection of twenty minims of chloroform into jugular vein; the effect is shown in Fick reading 5 and is identical with that produced by ether.
C. 4 5 55.—Injection of twenty minims of ether. See Fick reading 9. The injection was followed by rapid fall of pressure; the respiration stopped at 4 h. 6 m. 40 s.; gasping took place at 4 h. 8 m. 0 s.; the thorax was opened at 4 h. 9 m. 0 s., and the heart was found still, with a clot in the left ventricle. The disastrous effect of injecting ether after chloroform is well shown in this experiment.

November 11th.—No. 74.

Temperature of the room 19.5 Cent. Rather small pariah dog. Weight 21 lbs. Into chloroform box at 8 h. 13 m. 30 s. Fallen down at 8 h. 17 m. Placed on the table at 8 h. 21 m. 50 s. Temperature in the rectum 100.4 F. Left carotid ligatured at 8 h. 28 m. 10 s. Right jugular vein ligatured at 8 h. 33 m. and canula inserted into left carotid 8 h. 44 m. Connexion made with the manometers at 8 h. 46 m. 15 s. Two Ludwig and three Fick tracings.

Observations.

- H. M. S.
A. 8 47 30.—Ordinary chloroform administration.
B. 8 48 20.—Thrusting a needle into the heart.
C. 8 49 25.—Irritation with a 10 cent. coil of the right vagus entire (Fick reading 3).
D. 8 51 5.—Chloroform again rapidly. Stoppage of respiration and recovery with artificial respiration.
E. 9 0 0.—Injection of atropine 1-50th grain into the jugular vein.
F. 9 6 40.—Chloroform administration again during struggling; the respiration again stopping and necessitating artificial respiration.
G. 9 14 25.—Irritation of the right entire vagus.
H. 9 16 50.—Injection of 1-25th grain of atropine into jugular vein.
I. 9 22 5.—Irritation of right vagus again when animal under influence of atropine. Coils moved from 10 to 5 and then to 0 (Fick 13).
K. 9 34 30.—Pushing chloroform until death.

Heart was still beating 3 minutes after the pulse became imperceptible. Temperature after death 97.4 F.

Post-mortem—Two drachms of blood in the pericardium; no clot in heart.

November 11th.—No. 75.

Monkey (Macacus). Weight 15 lbs. Into chloroform box at 10 h. 29 m. 50 s. Fallen down at 10 h. 34 m. 30 s. Placed on the table at 10 h. 47 m. and kept quiet with chloroform from time to time. Temperature in the rectum 101.8 F. Loop under both vagi. Artificial respiration 10 h. 57 m. 15 s. to 10 h. 58 m. 5 s. Left carotid ligatured at 11 h. 1 m. 30 s. Canula inserted at 11 h. 4 m. 50 s. Connexion made with manometer at 11 h. 18 m. 10 s. Two Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 11 19 0.—Ordinary chloroform administration.
B. 11 21 20.—Holding ammonia before the nostril.
C. 11 24 40.—Holding acetic acid before the nostril.
D. 11 26 0.—Dropping a few minims of chloroform into the nostril.
E. 11 45 50.—Irritation of the entire right vagus, coil at 10 cents. (Fick 4).
F. 11 48 0.—The same with the Ludwig manometer connected.
G. 11 53 0.—Irritation of the entire right vagus, coil at 5 (Fick 5).
H. 11 58 40.—Irritation of the right vagus, coil at 0 (Fick 6).
I. 12 2 20.—Thrusting needle into the heart.
K. 12 3 45.—Pushing chloroform until death.

Needle entered the left ventricle. Temperature soon after death 97 F.

November 11th.—No. 76.

(In the presence of His Highness the Nizam.)

Pariah dog. Weight 37 lbs. Temperature of the room 23.5 Cent. Into chloroform box at 2 h. 21 m. 36 s. Fallen down at 2 h. 28 m. 30 s. Placed on the table at 2 h. 30 m. 50 s. and kept quiet with chloroform. Artificial respiration at 2 h. 40 m. 25 s. and until 2 h. 44 m. 15 s. Carotid ligatured at 2 h. 41 m. 5 s. Temperature in the rectum 100 F. Loop under both vagi. Connexion made with manometer at 2 h. 48 m. 25 s.—Two Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 2 48 25.—Ordinary chloroform administration in several instances.
B. 2 51 50.—Irritation of right vagus repeatedly (Fick 2-4).
C. 3 34 5.—The same after the injection of atropine into the jugular veins (Fick 6).
D. 3 40 0.—Thrusting needle into heart.
E. 3 42 30.—Inhalation of ammonia.

H. M. S.

- F. 3 43 0.—Pushing chloroform until after respiration had completely stopped, and then
G. 3 46 0.—Restoration by artificial respiration.
H. 3 48 20.—Pushing chloroform until death resulted.
Temperature after death 99.4 F.

November 12th.—No. 77.

Temperature of the room 18.5 Cent. Medium-sized pariah 26 lbs. Into chloroform box at 7 h. 27 m. 12 s. Fallen down at 7 h. 36 m. 50 s. On the table at 7 h. 38 m. 50 s. Artery ligatured at 7 h. 50 m. 10 s. Temperature in the rectum 99.2 F. Canula inserted into the left carotid at 7 h. 58 m. 50 s. Right jugular ligatured at 8 h. 3 m. 10 s. Connexion made with manometer at 8 h. 13 m. Three Ludwig and one Fick during repeated injection of ether into the jugular vein in doses of first 20 m., then 40 m., and 60 m., and finally 120 m. One injection of 60 m. was also made into the thigh subcutaneously. When the pulse was no longer perceptible, a needle was thrust into the chest, but did not reach the heart and consequently did not move. The dog was still gasping occasionally until the thorax was opened at 9 h. 12 m., when the heart was found to have ceased beating, but rhythmical waves in the heart-wall occurred until 9 h. 24 m., although the heart had been removed from the body and cut open. Temperature after death 98 F. Post-mortem—Large clot in left ventricle. Right side full of clots.

Observations.

- H. M. S.
A. 8 13 30.—Ether 20 minims injected into jugular vein; no effect.
B. 8 18 20.—Repeat injection of 20 minims of ether; this injection was followed by slight fall of blood-pressure.
C. 8 19 50.—Another 20 minims of ether injected into the jugular vein. The fall of blood-pressure again occurred to a greater extent.
D. 8 21 10.—Repeat ether injection. A still further fall of pressure is noticeable, and the recovery from this fall was slow.
E. 8 27 20.—Forty minims of ether injected into the jugular vein. A very rapid and deep fall of blood-pressure took place and the pulse tracing disappeared (vide Fick 4). During recovery at 8 h. 32 m. 0 s. and 8 h. 35 m. 0 s. the blood-pressure twice rose and fell again in a remarkable manner without any apparent cause. (Compare with Experiment 117, Observation G at 9 h. 23 m. 50 s. to 9 h. 25 m. 15 s.). The condition of respiration was not recorded at these times.
F. 8 40 0.—Repeat injection of 40 minims of ether into jugular. During recovery at 8 h. 47 m. 40 s. a drachm of ether was injected subcutaneously into the thigh. Recovery was arrested and a slight fall of pressure took place; but no marked effects were produced.
G. 8 50 20.—Injection of 60 minims of ether into jugular vein. This was followed by rapid fall of pressure and complete loss of pulse tracing, and the respiration stopped at 8 h. 53 m. 0 s. The pupils were widely dilated. The animal began gasping at 8 h. 54 m. 40 s., and recovery gradually took place, but the blood-pressure was not fully restored.
H. 9 7 40.—Repeat injection of ether into jugular vein. This time 120 minims were injected. The pressure rapidly fell again and the respiration stopped for 20 seconds, after the injection was concluded. A few gasps took place at 9 h. 10 m. 0 s.; the thorax was opened at 9 h. 12 m. 0 s. and rhythmical wave-like movements were observed in the ventricular walls of the heart, which continued until 9 h. 24 m. 0 s. after the heart had been removed from the body. Large round clots were found in the left ventricle extending into the aorta; and the right side was full of clot.

Experiment 77 shows that the effect of ether is precisely the same as that of chloroform, only less intense. Like chloroform, ether, when efficiently given, produces first narcosis, then stoppage of the respiration, and then death. All the observations in the experiment show that every time ether was injected into the blood, a fall of blood-pressure was produced; and yet it is the practice nowadays to inject ether subcutaneously when chloroform poisoning occurs. It would be just as sensible to inject chloroform subcutaneously in cases of poisoning from ether. Cases have even been recorded recently where ether has been injected subcutaneously in ether poisoning. This manifestly dangerous and unsound principle of treatment arises from the fact that ether is regarded as a safe stimulant, whereas it merely quickens the heart's beats. Experiment 77 shows that it is not a reliable stimulant under any circumstances.

November 12th.—No. 78.

Monkey (Macacus). Weight 10½ lbs. Temperature of the room 21 Cent. Into chloroform box at 10 h. 4 m. 30 s. On to table at 10 h. 9 m. 23 s. and kept quiet with chloroform. Temperature in rectum 98 F. Artery ligatured at 10 h. 34 m. 50 s. Loops under both vagi. Connexion made with manometer at 10 h. 46 m. 30 s. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 10 49 0.—Ordinary chloroform administration.
B. Violent struggling with great irregularity of blood-pressure.
C. 10 54 20.—Dropping chloroform into nostril; effect of struggling again shown.
D. 10 55 20.—Pushing chloroform until respiration stopped.
E. 11 6 20.—Mechanical irritation of the right vagus.
F. 11 7 0.—Electrical irritation of the entire right vagus, coils 10 cent. distant (Fick 8).
G. 11 10 50.—Ligature of the right vagus.
H. 11 16 35.—Division of the same.
I. 11 29 40.—Irritation of the peripheral end of the right vagus, coil at 10 (Ludwig tracing).
J. 11 31 0.—The same, only coil at 5 (Fick 9).

- H. M. S.
K. 11 33 0.—Injection of atropine into the peritoneal cavity.
L. 11 39 40.—Irritation of the peripheral right vagus again, coil 5 (Fick 11).
M. 11 45 30.—The same, only coil 0.

N.B.—The effect upon the blood-pressure of pushing chloroform was not nearly so great as in previous experiments, though the animal was very readily put "under."

Hopeless clotting stopped the manometer at 11 h. 56 m. 20 s., and the monkey was given chloroform finally with the view of killing it. Respiration stopped at 12 h. 4 m. 40 s.; pulse perceptible until 12 h. 6 m. 30 s. Heart-flag moving until 12 h. 9 m. 55 s. Thorax opened and heart still beating rhythmically at 12 h. 11 m. 35 s., a little blood passing into the aorta at each beat. The contractions became partial and ineffective at 12 h. 18 m. 40 s., but were re-established by compressing the septum and continued until 12 h. 28 m. Irregular flickering continued even after this for some minutes. Temperature 98 F. in the rectum.

November 12th.—No. 79.

Good-sized pariah, weight 33 lbs., that has had two doses of phosphorus—one yesterday, the other to-day, each 1-16th of a box of James' beetle paste. Into chloroform box at 2 h. 9 m. 34 s. Fallen down 2 h. 23 m. 39 s. Placed on the table at 2 h. 24 m. 26 s. Respiration stopped at 2 h. 24 m. 45 s. Artificial respiration until 2 h. 27 m. 39 s. Artery ligatured and canula inserted at 2 h. 36 m. 13 s. Temperature in the rectum 100 F. Connexion made with the manometer at 2 h. 39 m. 30 s. Two Ludwig and one Fick tracing.⁵

Observations.

- H. M. S.
A. 2 41 50.—Change to the vertical position of the body.
B. 2 43 10.—Chloroform administration while in the vertical position.
C. 2 44 45.—Ammonia inhalation do.
D. 2 46 40.—Squirting chloroform into the nose do.
E. 2 49 40.—Evulsion of the nails do.
F. 2 50 55.—Extraction of teeth do.
G. 2 52 55.—Violent slap with open hand on abdomen do.
H. 2 54 30.—Restoration to the recumbent position on the table.
I. 2 56 20.—Inversion of the body so that the dog was completely head downwards and again lowering to the recumbent position.
J. 2 57 40.—Chloroform administration in the ordinary position.
K. 3 1 0.—Attempts to pass grooved staff and Thompson's dilators into the bladder.
L. 3 15 5.—Slitting prepucis.
M. 3 17 20.—Pushing chloroform carelessly until after respiration had ceased.

Temperature after death 99 F. The organs did not appear to be fatty.

Remarks.—No. 79 shows the effects of different positions of the body on the blood-pressure, and of attempts to produce shock by various operations in different stages of chloroform inhalation. In this experiment the exact time of the final stoppage of the respiration was not noted, as the chloroformist was watching the operations. The respiration had stopped some time before the fact was observed, and the animal died in spite of artificial respiration. The heart continued to beat feebly for seven minutes after the commencement of artificial respiration.

November 13th.—No. 80.

Large monkey (Macacus), 21 lbs., caught in the hospital compound. Into chloroform box at 3 h. 31 m. 38 s. On the table and kept quiet with chloroform 3 h. 37 m. 40 s. Temperature 100.2 F. Canula inserted into left carotid. Loop under both vagi. Connexion made with manometers at 2 h. 39 m. 30 s.

Two Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 4 7 40.—Ordinary chloroform administration. The effect of struggling is well shown.
B. 4 11 0.—Irritation of right vagus, entire, coils 8½ cent. distant (Fick 4).
C. 4 14 10.—Irritation of left vagus, entire, 8½ coil (Fick 5).
D. 4 14 50.—Chloroform again.
E. 4 17 45.—Injection of ¼ grain atropine into peritoneal cavity.
F. 4 19 30.—Irritation of right vagus, coil 8½ again (Fick 6).
G. 4 20 30.—Irritation of entire left vagus, coil 0 (Fick 7).
H. 4 22 30.—Pushing chloroform until respiration stopped completely, and restoration by artificial respiration. The effect of struggling is well brought out in this observation.
(Manometer tracing was interrupted at 4 h. 33 m. to divide the left splanchnic nerve and started afresh at 4 h. 49 m. 50 s. after cutting the left splanchnic nerve which did not appear to effect pressure much.)
I. 4 50 40.—Administration of chloroform for a short time.
J. 4 53 0.—Evulsion of nails.
K. 4 56 30.—Squeezing and afterwards smashing the testicles.
L. 4 58 20.—Pushing chloroform.
M. 4 59 0.—Thrusting needle into the heart and death.

Slow gasping movements of the chest continued after the heart had ceased to beat. Temperature after death 98.2 F. Post-mortem—There was very little hemorrhage into the abdomen. The left splanchnic divided, right intact. No clot in heart.

November 13th.—No. 81.

Medium-sized pariah dog, weight 30 lbs., which has been dosed with phosphorus for 2 days, 1-16th of a box of paste each day. Into chloroform box at 7 h. 50 m. 30 s. Fallen down at 8 h. 1 m. Placed on the table at 8 h. 4 m. 20 s. Carotid ligatured at 8 h. 14 m. 10 s. Canula inserted at 8 h. 19 m. 30 s. Temperature 100.4 F. in the rectum.

⁵ See tracings appended, page 58.

Connexion made with manometers at 8 h. 25 m. 10 s. Loops under both vagi. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 8 28 30.—Application of bicarbonate of soda to the entire right vagus.
B. 8 30 35.—Change to the vertical position and restoration to the recumbent again.
C. 8 33 20.—Chloroform administration.
D. 8 37 10.—Blow on testicles.
E. 8 41 0.—Pushing chloroform with struggling until respiration ceased (*vide* Fick 5 and 6).
F. 8 42 10.—Artificial respiration.
G. 8 47 30.—Injection of ½ grain atropine into the peritoneum.
H. 8 53 10.—Irritation of right entire vagus, coil at 0.
I. 8 56 0.—The same (*vide* Fick 9).
J. 8 57 30.—Pushing chloroform with violent struggling.

Fall of pressure very rapid, and the dog died in spite of artificial respiration. A clot in the vessels interrupted the tracing before the heart stopped. Temperature after death 97.4 F. Post-mortem—Organs not particularly fatty.

Nov. 13th.—No. 82.

Good-sized monkey (Macacus). Weight 15 lbs. Temperature of the room 20.5 Cent. Into chloroform box at 10 h. 57 m. 18 s. Fallen down at 10 h. 4 m. 17 s. On the table at 10 h. 6 m. 52 s. and kept quiet with chloroform. Artery ligatured at 10 h. 35 m. 53 s. Canula inserted at 10 h. 39 m. 30 s. Temperature 99.2 F. in the rectum. Connexion made with manometers at 10 h. 47 m. 50 s. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 10 53 30.—Chloroform administration on a cap in the ordinary way; violent struggling.
B. 10 58 10.—Pushing chloroform until respiration stopped; recovery without artificial respiration.
C. 11 10 20.—Division of both vagi.
D. 11 19 10.—Pushing chloroform until death resulted.
Temperature after death 99.4 F.

November 13th.—No. 83.

Medium-sized monkey (Macacus). Weight 12 lbs. Temperature of the room 23 Cent. Into chloroform box at 2 h. 21 m. 33 s. Fallen down at 2 h. 30 m. 15 s. Placed on table at 2 h. 32 m. 10 s. Carotid ligatured at 2 h. 39 m. 35 s. and canula inserted. Temperature in the rectum 103.2 F. Kept quiet with chloroform until connexion made with manometers at 2 h. 46 m. 15 s. Three Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 2 47 0.—Gradual coming out of chloroform.
B. 2 49 0.—Ordinary chloroform administration with struggling, showing great irregularity of the blood-pressure.
C. 2 52 0.—Change of position to the vertical, during which—
D. 2 53 0.—Extraction of teeth.
E. 2 55 20.—More chloroform and struggling at intervals.
F. 2 58 30.—Restoration to recumbent position.
G. 3 5 0.—Exposure of the ulna nerve at the elbow.
H. 3 7 0.—Tugging at the ulna nerve.
I. 3 8 20.—Incision into abdomen over the stomach.
J. 3 16 0.—Ligature of a glass tube into that organ; stitching of the abdominal wound.
K. 3 19 20.—Inflation of stomach with air and suddenly allowing the air to escape.
L. 3 25 0.—Re-opening the wound and re-adjusting the stomach tube and re-stitching the abdominal wound.
M. 3 42 40.—Injection of hot water into stomach.
N. 4 0 0.—Injection of one-twelfth grain apomorphine into peritoneum.
O. 4 1 0.—Placing a thermometer in the rectum.
P. 4 2 30.—Artificial respiration at times, the respiration being gasping and irregular.
Q. 4 9 40.—Iced water into stomach: running out through the nose.

Experiment interrupted by hopeless clotting at 4 h. 12 m. Stopped breathing at 4 h. 17 m. 40 s. The heart-needle stopped moving a few seconds before the thorax was opened and the heart was found to be quite still. Temperature after death 97.8 F.

November 14th.—No. 84.

Temperature of room 19.75 Cent. Medium-sized, well-nourished pariah dog, weight 35½ lbs., who has had daily doses of phosphorus for three days. Chloroform commenced in box at 7 h. 37 m. Fallen down at 7 h. 42 m. On table at 7 h. 44 m. 45 s. Artery ligatured at 8 h. 52 m. and canula inserted. Temperature in the rectum 100.8 F. Connexion made with manometers at 8 h. 10 m. 30 s. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 8 13 20.—Division of rectus muscle of the eye-ball.
B. 8 16 20.—Blow on the testicle.
C. 8 24 0.—Chloroform administration repeatedly, often accompanied by struggling.
D. 8 24 40.—Evulsion of nails.
E. 8 25 39.—Snipping anus.
F. 8 27 0.—Pushing chloroform until respiration ceased.
G. 8 29 40.—Artificial respiration.
H. 8 41 0.—Exposure, ligature, and division between ligatures of both vagi.
I. 8 45 30.—Pushing chloroform until respiration ceased; fatal result (*vide* Fick 8).

From the character of Fick reading 8 and the Ludwig tracing just before, it is doubtful if the vagi were really divided. Temperature after death 97 F.

In this experiment the absence of any effects from the operations which are usually said to be dangerous under chloroform is well brought out; also the rapid and irregular falls of the blood-pressure when the animal struggles and breathes irregularly during the inhalation of the anæsthetic.

November 14th.—No. 85.

Temperature of the room 21 Cent. Medium-sized dog, weight 30½ lbs., that has had phosphorus daily for 3 days, 1-16th of a box. Into chloroform box at 9 h. 42 m. Fallen down at 9 h. 45 m. 10 s. Placed on the table at 9 h. 46 m. 45 s., after which its breathing was noticed to have stopped. Artificial respiration was commenced at once, but failed to bring him round, although there was a pulse some time after it commenced.

This is a case where a weak sick animal was left in the chloroform box too long, and its respiration neglected while it was being transferred to the table.

November 14th.—No. 86.

Monkey (medium-sized *Macacus*). Weight 11 lbs. Into chloroform box at 10 h. 27 m. 22 s. Fallen down at 10 h. 13 m. 15 s. Placed on the table and kept quiet with chloroform. Carotid ligatured at 10 h. 33 m. 40 s. Canula inserted at 10 h. 39 m. 30 s. Temperature in the rectum 101 F. Connexion made with the manometers at 12 h. 44 m. Three Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 10 45 20.—Small incision into abdomen.
B. 10 47 10.—Administration of chloroform; struggling, and irregularity of the blood-pressure.
C. 10 49 50.—Injection of 1-12th grain apomorphine into abdominal cavity. (The animal then lay almost perfectly quiet without more chloroform for almost an hour, during which he was given another dose of apomorphine 1-12th grain.)
D. 11 43 30.—Pushing chloroform, with struggling, until respiration ceased; recovery with artificial respiration.
H. 11 46 0.—Thrusting a needle into the chest but not into the heart.
F. 11 51 30.—Effect of letting the tongue drop.
G. 11 54 30.—Repetition of D and E, and thrusting a needle into the heart.
H. 12 19 0.—Injection of atropine, ½ grain, in abdomen, and finally pushing chloroform until death resulted.

Thorax opened at 12 h. 26 m. respiration having stopped, but afterwards there were again regular movements of the diaphragm, which continued off and on until 12 h. 23 m. 50 s., when they finally stopped. The tracing was stopped by hopeless clotting at 12 h. 31 m. Heart stopped very gradually, but not finally until 12 h. 37 m. Temperature after death 95.4 F.

November 14th.—No. 87.

Mr. Ulett's bull dog, weight 31 lbs., suffering from tumours in the inguinal region. Into chloroform box at 2 h. 14 m. 10 s. Fallen down at 2 h. 23 m. 10 s. Placed on the table and kept quiet with chloroform. Temperature in the rectum 102 F. Loops under both vagi. Artery ligatured at 2 h. 34 m. 30 s. Canula inserted 2 h. 40 m. 20 s. Connexions made with manometers at 2 h. 43 m. 40 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 2 46 30.—Ordinary chloroform administration.
B. 2 48 0.—Irritation of entire right vagus with coils at 5 centimetre distance.
C. 2 53 50.—Pushing chloroform, with accidental compression of the neck by a strap (*vide* Fick 3). The same slowing of the pulse was produced as is observed when the vagus is irritated.
D. 3 0 0.—Pushing chloroform until respiration completely ceased.
Failure to restore the animal by artificial respiration.
Temperature after death 101.2 F.

November 14th.—No. 88.

Temperature of room 24 Cent. Medium-sized pariah dog. Weight 30 lbs. Into chloroform box at 3 h. 22 m. 26 s. Fallen down at 3 h. 24 m. 45 s. Placed on the table at 3 h. 25 m. 25 s. Artery ligatured at 3 h. 37 m. Temperature in the rectum 100.2 F. Canula inserted at 3 h. 40 m. 53 s. Connexion made with manometers at 3 h. 50 m. 11 s. Loops under both vagi. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 3 51 0.—Pushing chloroform accompanied by struggling until respiration stopped. (The trace is spoilt by the drum not rotating for nearly a minute.) The fall of pressure was extremely rapid and irregular. Fick 2 shows that when the respiration is stopped by an over-dose of chloroform, a condition of pulse similar to that caused by vagus stimulation may be produced.
B. 3 52 50.—Recovery with artificial respiration.
C. 3 59 20.—Pressure on abdomen.
Pushing chloroform again until respiration stopped.
D. 4 1 0.—Division of both vagi while the animal was deeply under. Fick 5 shows that after division of the vagi the slowing of the pulse observed in stoppage of the respiration in chloroform poisoning did not occur.
E. 4 4 0.—Gradual fall of pressure and death in spite of artificial respiration.
Temperature after death 98.4 F.

November 15th.—No. 89.

Temperature of the room 21 Cent. Unusually large blindfold dog. Weight 38 lbs. Into chloroform box at 7 h. 33 m. Fallen down at 7 h. 46 m. 20 s. Placed on the table 7 h. 43 m. 50 s. Temperature in the rectum 99.8 F. Left carotid ligatured at 8 h. 2 m. 5 s. Connexion made with manometer at 8 h. 6 m. 30 s. Four Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 8 10 45.—Chloroform administration with struggling (the excursions of the marker had previously been unusually great), and pushing the same until respiration ceased.

H. M. S.

- B. 8 24 20.—Artificial respiration and gradual recovery.
C. 8 23 30.—Division of both vagi.
Administration of chloroform again until respiration ceased, and
Artificial respiration as before.
G. 8 47 40.—Compression of the chest and administration of chloroform on a saturated sponge at the moment the chest was released.
F. 8 51 0.—Pressure on abdomen.
G. 8 51 0.—Pushing chloroform again until respiration stopped; and artificial respiration as before.
H. 8 55 40.—Tracheotomy and insertion of a large glass tube into the trachea.
I. 8 59 0.—Repetition of F by stopping the tracheal tube when the chest was in the expiratory position, holding chloroform in front of the tube, and then suddenly opening it.
J. 9 5 40.—Continued administration of chloroform by holding a sponge or towel before the end of the tube.
K. 9 7 15.—Closing the tracheal tube so as to cause asphyxia.
L. 9 12 25.—Administration of chloroform by Junker's tube introduced into the tracheal tube, which remained open, and pushing it again until respiration stopped, and artificial respiration as before.
M. 9 26 10.—Administration of ether in the same way, but this failed to keep the animal thoroughly under. After chloroform had been again given the manometer was disconnected in order to divide the medulla oblongata.

All attempts to reconnect after its division failed on account of clot in the vessel, and the heart ceased beating at 11 h. Temperature at 11 h. 5 m. 96 F. in the rectum.

In this experiment slowing of the pulse, in Observations A and B, which occurs when the respiration fails from overdosing with chloroform is shown (*vide* Fick 6 and 9). This effect is not produced after division of the vagi (*vide* Fick 10 and 11). The effect of asphyxia in lowering the blood-pressure is also seen in the Ludwig tracing at 9 h. 7 m. 20 s. and 9 h. 9 m. 40 s. The difference in intensity between diluted chloroform and diluted ether, administered in precisely the same way, is brought out in Observations L and M.

November 15th.—No. 90.

Medium-sized strong pariah, given 1 grain of morphine hypodermically at 2 h. 24 m. 10 s. Temperature of the room 24½ Cent. Salivated a good deal at 2 h. 33 m. and afterwards went to sleep. At 4 h. 15 m. he was still irritable and unfit for the experiment.

November 18th.—No. 91.

Large pariah dog, 38 lbs. Temperature of the room 24.5 Cent. Chloroform given at 2 h. 34 m. 45 s. Fallen down at 2 h. 41 m. 30 s. On the table at 2 h. 43 m. 15 s. and kept quiet with chloroform. Temperature in the rectum 100.4 F. Right jugular vein ligatured at 2 h. 51 m. Canula into carotid at 2 h. 58 m. 5 s. Connexion made with manometers at 3 h. 1 m. 33 s. The pressure in the manometer had been arranged a little too high before commencing, so that some bicarbonate of soda must have been shot into the vessel. No convulsions occurred. Three Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 3 6 0.—A long period in which the dog was left without chloroform and occasionally struggled.
B. 3 35 20.—Injection at different times of 5 doses of chloroform, 20 minims each (except in one instance when about 5 minims or possibly more was spilled), into the jugular vein. After the 5th dose the dog died, the heart stopping at 4 h. 13 m. Temperature in rectum at death 97.2 F. Post-mortem—No clots in heart.

November 18th.—No. 92.

Temperature of the room 23 Cent. Large-sized pariah dog. Weight 33½ lbs., rather thin. In chloroform box at 7 h. 24 m. 43 s. Fallen down at 7 h. 25 m. 53 s. On the table at 7 h. 29 m. 37 s. Artery ligatured at 7 h. 41 m. 8 s. and canula inserted. Temperature in the rectum at 7 h. 42 m. 30 s., 100.6 F. Jugular vein tied at 7 h. 51 m. 47 s. Connexion made with the manometers at 7 h. 58 m. 20 s. Three Ludwig and one Fick tracing during repeated injections of chloroform into jugular vein.⁶ Nine doses were given in the course of an hour, and death ensued very gradually. Temperature after death 97 F. Post-mortem—After the chest was opened 5 or 6 regular movements of opening and shutting the jaws coincident with rhythmical contractions of the diaphragm occurred. The heart was quite still in all its cavities. There were no clots in the heart. No sign of the needle in the heart.

Observations.

- H. M. S.
A. 8 0 15.—Twenty minims of pure chloroform injected into the jugular vein.
B. 8 2 40.—Repeat.
C. 8 3 50.—Repeat.
D. 8 5 55.—Repeat.—This injection was followed by lowering of the blood-pressure, which never rose again. The injection of twenty minims of chloroform was repeated at 8 h. 13 m. 20 s.; 8 h. 14 m. 10 s.; 8 h. 40 m. 30 s.; 8 h. 43 m. 20 s.; and 8 h. 46 m. 10 s.

It seems clear from experiment No. 92 that direct action of chloroform upon the heart substance is not the cause of the fall of blood-pressure that occurs when it is inhaled. Repeated injections of twenty minims of pure chloroform were made into the jugular vein, and the effect was not to paralyse the heart, but to produce narcosis with a gradual fall of pressure exactly as if the chloroform had been inhaled. Compare with Observation D of Experiment No. 64.

⁶ See tracings given on pp. 59 and 60

November 18th.—No. 93.

Temperature of the room 24 Cent. Large pariah dog. Weight 33½ lbs. Into chloroform box at 9 h. 59 m. Fallen down at 10 h. 5 m. 25 s. On the table at 10 h. 5 m. 27 s. and kept quiet with chloroform. Artery ligatured at 3 h. 20 m. 50 s. Canula inserted at 3 h. 22 m. 22 s. Temperature in rectum 99.8 F. Connexion made with manometer 10 h. 28 m. 45 s. Two Ludwig and one Fick tracing during injection of ether into the jugular vein with at the same time injection of solution of hydrochloric acid (0.8 per cent.) in normal saline solution into the femoral vein. Notice also effect of thrusting needle into heart. Temperature 101.2 F. after death. Post-mortem—Heart very much distended. Right ventricle full of clot. Left free. Superior and inferior vena cava and pulmonary artery filled with clot.

H. M. S.

Observations.

- A. 10 80 10.—Ether on an ordinary cap until 10 h. 39 m. 40 s. The animal was quiescent, but complete narcosis was not produced. A great deal of frothy fluid accumulated in the trachea.
- B. 10 40 20.—Twenty minims of ether injected into the jugular vein. The injection was repeated at 10 h. 41 m. 10 s. and 10 h. 42 m. 15 s., and each time the blood-pressure fell and rose again in 40 or 50 seconds. At 10 h. 47 m. 10 s. and again at 10 h. 52 m. 30 s. forty minims of ether were injected. There was on each of these occasions a very rapid and prolonged fall of blood-pressure and a slow weak pulse with very difficult recovery.
- C. 11 1 30.—Injection of sixty minims of ether into the jugular vein. The fall of blood-pressure was immediate and rapid, and the pulse tracing became almost imperceptible (*vide* Fick 6 and 7). The pressure remained low until 11 h. 5 m. 20 s., when slight recovery took place (*vide* the Ludwig tracing at 11 h. 5 m. 0 s., p. 60). At 11 h. 6 m. 0 s. sixty more minims of ether were injected into the jugular vein, and this injection caused stoppage of the respiration and death. Post-mortem gasps occurred as in Experiment No. 92. The heart was found full of venous clot.

November 18th.—No. 94.

The dog in No. 90 having escaped from the cage, another dog was given 2 grains of morphia at 2.30 a.m. At 10 o'clock he was still irritable and unfit for experiment, for, although sleepy and at first sight apparently insensitive, he could be easily aroused by even painless stimuli and then ran about in an excited, wild way.

November 18th.—No. 95.

Temperature of the room 25½ Cent. Monkey (medium-sized Macacus). Held down on table and given ether on a cap at 2 h. 50 m. 45 s., his temperature in rectum being 102.4 F. at that time. Ether stopped at 2 h. 51 m., the animal being quite quiet, though cornea not insensitive. Respiration chiefly abdominal, 68 per minute. Artery ligatured at 3 h. 7 m. 45 s., and loop placed under left vagus. Canula inserted into artery at 3 h. 11 m. 33 s. Left jugular accidentally cut; so ligatured. Loop under right vagus and right carotid. Ether given now and again during above proceedings. Connexion made with manometer at 3 h. 26 m. 50 s. Two Ludwig and three Fick tracings.

Observations.

H. M. S.

- A. 3 26 50.—The quiescent condition, not anæsthesia, produced by ether.
- B. 3 28 10.—Irritation of the nostril by chloroform, and
- C. 3 29 15.—Ammonia.
- D. 3 36 5.—Clamping of the right carotid so as to cut off both carotids.
- E. 3 35 0.—Extraction of teeth with the key. (*Vide* Fick reading marked "6" on the Fick tracing, but noted as "5" on the Ludwig tracing.)
- F. 3 50 10.—Exposure and irritation of the sciatic nerve.
- G. 3 53 30.—Irritation of the entire left vagus coil 10 producing coughing (Fick 6).
- H. 3 54 40.—Irritation of the entire left vagus coil 10 (Fick 9).
- I. 3 55 50.—Irritation of the entire right vagus coil 5 (Fick 10). (The effect of irritation of the right was less than that of the left vagus.)
- J. 4 0 30.—Ligature and division of the right vagus (Fick 11).
- K. 4 14 55.—Irritation of central right vagus coil 5 (Fick 14).
- L. 4 17 15.—Irritation of peripheral right vagus coil 5 (Fick 15).
- M. 4 20 0.—Ligature and division. Fick 16) of left vagus.
- N. 4 21 30.—Irritation of central left vagus coil 5 (Fick 17).
- O. 4 25 0.—Irritation of peripheral left vagus coil 5 on two occasions (Fick 18, 19), but doubtful if the nerve was really irritated in the first.
- P. 4 37 0.—Pushing ether on cap closely applied over muzzle until death ensued.

Manometer stopped on account of clot at 4 h. 45 m. Needle into heart; hardly moving. Thorax opened 4 h. 46 m. 20 s. Heart still. No clots in the heart cavities. Temperature at 4 h. 35 m. 40 s. in the rectum 100.2 F.

November 19th.—No. 96.

Temperature of the room 23 Cent. Medium-sized female monkey (Macacus). Weight 11½ lbs. Into chloroform box at 9 h. 23 m. Fell down at 9 h. 31 m. On the table at 9 h. 33 m. Temperature in rectum 100.4 F. Artery ligatured at 9 h. 52 m. 50 s. Canula inserted at 9 h. 58 m. Connexion made with manometer at 10 h. 6 m. 40 s. Two Ludwig and one Fick tracing.

Observations.

H. M. S.

- A. 10 8 20.—Ordinary chloroform administration.
- B. 10 16 40.—Bandaging the abdomen.
- C. 10 21 0.—Bandaging the lower chest with plaster of Paris.

Death ensued from asphyxia and in spite of artificial respiration after removal of the bandage. Post-mortem—Heart cavities firmly contracted after death, and lungs engorged. Trachea full of froth. Temperature at end of Experiment 96.2 F. in rectum.

November 19th.—No. 97.

Medium-sized female monkey. Weight 9½ lbs. Temperature of the room 23½ Cent. Into chloroform box at 10 h. 50 m. Fallen down at 0 h. 58 m. 30 s., and placed on the table. Temperature in rectum 102.4 F. Artery ligatured at 11 h. 11 m. 10 s., and canula inserted. Connexion made with manometers at 11 h. 24 m. 50 s. One Ludwig and one Fick tracing.

Observations.

H. M. S.

- A. 11 26 30.—Struggling.
- B. 11 27 30.—Application of a plaster of Paris bandage to the chest to imitate stays, and of
- C. 11 32 0.—A tight broad tape round the lower part of the abdomen to imitate the effect of petticoats.
- D. 11 33 0.—Pushing chloroform until respiration stopped.

Death ensued although the bandages were quickly removed and in spite of artificial respiration. Post-mortem—Blood, arterial, in left side of heart. Temperature after death 102.4 F.

November 19th.—No. 98.

Small monkey fastened on to the rabbit board at 3 h. 14 m. 30 s. A pin placed in the heart and connected by a thread with a time-marker writing on a quick revolving drum (the same as is used for the Fick manometer). The experiment was imperfect, but a few readings are preserved showing effect of placing ammonia before the nose.

November 20th.—No. 99.

Small rabbit on to rabbit board at 7 h. 30 min. with a needle in its heart attached by a long thread to a time-marker. The trace shows the effect of holding ammonia before the nose.

November 20th.—No. 100.

A monkey arranged in the same way. One trace showing the absence of any effect when ammonia is held before the nose, corresponding to that which occurs in the rabbit.

November 20th.—No. 101.

Small rabbit arranged as above and chloroform held before his nose. One tracing incorporated with the first tracing of 102.

November 20th.—No. 102.

Another rabbit in the same way. Chloroform given as before. Two tracings.

November 20th.—No. 103.

Large monkey. Weight 16½ lbs. Temperature of the room 24 Cent. Into chloroform box at 9 h. 8 m. 44 s. Fallen down at 9 h. 15 m. 5 s. Placed on the table at 9 h. 19 m. Temperature in rectum 101.8 F. Artery ligatured at 9 h. 37 m. 10 s. Canula inserted at 9 h. 40 m. 30 s. Connexion with manometer at 10 h. 3 m. 15 s. Four Ludwig tracings and three Fick.

Observations.

H. M. S.

- A. 10 6 20.—Mechanical irritation of the left vagus.
- B. 10 7 30.—Struggling.
- C. 10 8 20.—Irritation of the entire right vagus, coils 10 Cent. apart (Fick 4).
- D. 10 14 55.—Irritation of the entire left vagus (Fick 5).
- E. 10 17 30.—Irritation of the left vagus and pushing chloroform at the same time.
- F. 10 24 40.—Ordinary chloroform administration.
- G. 10 27 15.—Extraction of teeth (Fick 10).
- H. 10 42 0.—Blow on the abdomen with a fly-flapper (Fick 13).
- I. 10 49 10.—Attempts to pass a grooved staff into bladder.
- K. 10 54 0.—Castration.
- L. 11 5 0.—Electrical irritation of the spermatic cord.
- M. 11 5 40.—Exposing the femoral vessels.
- N. 11 16 20.—Transfusion of saline solution, about 220 c.c., into the femoral vein.
- O. 11 26 0.—Exposing and destroying the left splanchnic nerve and plexus, during which operation the aorta was accidentally snipped, but the opening was at once closed by a clamp and very little hæmorrhage occurred.
- P. 11 39 10.—Thrusting a needle into the heart.
- Q. 11 43 0.—Pushing chloroform until death with attempted restoration by means of transfusion of saline solution and artificial respiration.

After the thorax was opened and the heart found to have quite ceased beating, rhythmical movements of the diaphragm occurred. The heart continued irritable for some minutes. Temperature after death 97.2 F.

In Experiment 103, as well as in Experiments 80 and 92, rhythmical movements of the diaphragm were noticed after the heart had ceased beating and after the chest had been opened. In Experiment 103 the splanchnic nerve had been divided, death and stoppage of the heart were very gradual, and the heart was still irritable during the diaphragmatic contractions.

November 20th.—No. 104.

A dog, weight 36½ lbs., which had been dosed with phosphorus for two days. Into chloroform box at 2 h. 22 m. 5 s. Fell down at 2 h. 26 m. 35 s. On the table at 2 h. 29 m. 30 s., and kept quiet with chloroform. Temperature in rectum 100.4 F. Artery ligatured at 2 h. 34 m. 7 s. Canula inserted at 2 h. 36 m. 7 s. Connexion with manometer at 2 h. 40 m. 45 s. Three Ludwig and three Fick tracings.

Observations.

H. M. S.

- A. 2 41 0.—Struggling at various times.
- B. 2 41 30.—Chloroform administration; violent blow on the testicle at 2 h. 41 m. 50 s. No shock.
- C. 2 42 30.—Slight embarrassment of the respiration, from the foreleg being tightly bound down to the board. (*Vide* Fick 1 and 2).
- D. 2 48 40.—Pushing chloroform until respiration stopped.

During this observation the animal held his breath, the pulse tracing was immediately lost and the pressure fell exactly as in the Glasgow experiments A and C.

- H. M. S.
 E. 2 51 10.—Artificial respiration (*vide* Fick 5), when the normal respiration was recommencing. The slow pulse is very noticeable in this observation.
 F. 2 53 50.—Change to the vertical position and while vertical more blows on the testicle, and dental operations were performed, without the production of shock.
 G. 3 2 40.—Incising the abdomen.
 H. 3 3 30.—Blowing apomorphia 1-12th grain in solution into the peritoneal cavity; vomiting (Fick 9).
 I. 3 23 0.—Small opening into the larynx and injection of a few drops of chloroform.
 J. 3 26 30.—Pushing chloroform again until respiration ceased and artificial respiration (*vide* Fick 12).
 K. 3 34 40.—Seizing and snipping the skin of the anus.
 L. 3 35 40.—Larger opening into abdomen and tying a tube into the stomach.
 M. 3 41 40.—Distension of the stomach with air.
 N. 3 49 55.—Pulling the stomach forcibly.
 O. 3 52 10.—Pushing chloroform very far, and prolonged artificial respiration.
 P. 3 59 10.—Electrical stimulation of the heart.
 Q. 4 5 50.—Placing ice on the abdominal cavity.
 R. 4 9 0.—Pushing chloroform again until death resulted.

After the thorax was opened 37 rhythmical contractions of the diaphragm occurred, but the heart continued beating for more than two minutes after these had stopped. Post-mortem—Temperature 98.2 F. Weight post-mortem 34½ lb.

November 21st.—No. 105.

Large-sized pariah dog, weight 30½ lb., which has had three doses of phosphorus previously on the 18th, 19th, and 20th instant, respectively. It is in consequence very much out of sorts, and, judging from previous experiments with other dogs, would certainly have died in a few hours. Into chloroform box at 7 h. 44 m. 25 s. Fallen down at 7 h. 48 m. 55 s. Placed on the table and a canula inserted into left carotid. Temperature in rectum 102 F. Connexion made with manometers at 8 h. 9 m. 10 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 8 12 50.—Pushing chloroform until respiration ceased (*vide* Fick 2 and 3).
 B. 8 16 50.—Recovery by artificial respiration.
 C. 8 22 35.—Snipping skin of the anus (*vide* Fick 5). No sign of shock.
 D. 8 24 30.—Ordinary chloroform administration (trace imperfect owing to the drum sticking).
 E. 8 28 55.—Pushing chloroform again and death in spite of artificial respiration.

The trachea was for some reason considerably obstructed with fluid, so that the animal was probably in a state of partial asphyxia. Temperature at death 100.8 F.

November 21st.—106.

Large-sized pariah. Weight 25½ lbs. Has had three daily doses of phosphorus on 18th, 19th, and 20th evenings. Given chloroform at 9 h. 6 m. Fallen down at 9 h. 15 m. 30 s. On the table at 9 h. 16 m. Artery ligatured at 9 h. 25 m. 30 s. Temperature in rectum 100.2 F. Canula inserted at 9 h. 29 m. 30 s. Connexion made with manometer at 9 h. 41 m. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 9 42 20.—Ether administration on cap.
 B. 9 46 10.—Pushing ether until respiration stopped. Fick 4 shows exactly the same absence of pulse tracing which is noted so frequently in chloroform poisoning when the respiration stops (*vide* Experiment No. 107, Fick 3, and Experiment No. 178—all the tracings).
 C. 9 52 0.—Artificial respiration; and
 D. 9 54 30.—Inversion of the body failed to restore the animal. Temperature after death 97.8 F. Post-mortem.—There was a severe rupture in the liver and a quantity of blood in the peritoneum. Liver distinctly soft, friable, and pale in colour.
 Experiment No. 106 shows the effect of inversion of the body, which is now-a-days thought to be a restorative in chloroform poisoning. Inversion of the body causes the pressure in the carotid to rise, but it falls to its former state when the animal is replaced in the horizontal position. In Observation D. at 9 h. 54 m. 30 s., when the animal was in the last stage of ether poisoning, inversion of the body raised the pressure in the usual way as long as it was continued; but it failed to restore the respiration and the dog died. The change in the blood-pressure in the carotid, which occurs when the position of the body is changed, appears therefore to be due simply and solely to the effect of gravity. Experiment No. 106 also proves that the effect of ether is precisely the same as that of chloroform only less intense.

November 21st.—No. 107.

Large-sized pariah. Weight 28 lbs. Has had two doses of phosphorus on the 18th and 19th instant, respectively. Into chloroform box at 10 h. 9 m. 14 s. Fallen down at 10 h. 14 m. 27 s. On the table at 10 h. 17 m. 30 s. Artery ligatured at 10 h. 24 m. 13 s. and canula inserted. Temperature, 99.8 F. in rectum. Loop under both vagi and the right carotid. Connexion made with manometers at 10 h. 38 m. Pressure much too high; so much soda solution must have been shot into the artery (*vide* Ludwig tracing).
 One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 10 36 0.—Coming out of chloroform.
 B. 10 43 20.—Mild irritation (coil 15) of the entire right vagus (Fick 2).
 C. 10 44 20.—Pushing chloroform until respiration stopped (*vide* Fick 3), pulse tracing absent, this not being a sign that the heart had stopped; it was restored easily by artificial respiration.
 D. 10 46 0.—Recovery with artificial respiration.
 E. 10 51 0.—Ligature and division of the right vagus (Fick 5).

- H. M. S.
 F. 10 53 10.—Mild irritation (coil 15) of the peripheral end of the right vagus (Fick 6). Pushing chloroform again during struggling until death occurred in spite of artificial respiration.

The temperature in rectum was noted at intervals throughout (*vide* Ludwig tracing).

November 21st.—No. 108.

Large pariah. Weight 26 lbs. Has had two one-grain pills of phosphorus on the 18th and 19th instant, respectively. Into chloroform box at 11 h. 23 m. Fallen down at 11 h. 27 m. 45 s. On the table at 11 h. 30 m. 25 s. and kept quiet with ether. Temperature 100.8 F. in rectum at 11 h. 33 m. Artery ligatured at 11 h. 37 m. 45 s. Canula inserted at 11 h. 41 m. 30 s. Temperature 103.6 F. at 11 h. 47 m. 15 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 11 57 40.—Continued ether administration, which failed for a long time to keep the cornea insensitive, and was only effective when the animal was half smothered.
 B. 12 0 40.—Mild irritation of the entire right vagus, coil 15 (Fick 2).
 C. 12 2 0.—Convulsion of the whole body.
 D. 12 10 30.—Irritation of right vagus, coil 10 (Fick 6). This reduced the pulse from 120 to 37 a minute.
 E. 12 14 40.—Ligature and division (Fick 7) of the right vagus.
 F. 12 16 0.—The ether was pushed until death ensued.

Tracing stopped at 12 h. 21 m. Heart still moving when the thorax was opened at 12 h. 25 m. Temperature 97.4 F. Heart flickering at 12 h. 27 m.

November 22nd.—No. 109.

Medium-sized pariah, weight 27 lbs., that has had three doses of phosphorus on the 18th, 19th, and 20th instant, and is in an extremely feeble state. Chloroformed in the box at 8 h. 9 m. Fallen down at 8 h. 17 m. 15 s. Placed on the table at 8 h. 19 m. 20 s. Noticed to have stopped breathing at 8 h. 19 m. 40 s. Artificial respiration begun at once. Needle in the heart moving feebly at 8 h. 21 m. 45 s. Breathing spontaneously at 8 h. 23 m. 20 s., but artificial respiration continued in the ordinary way. Respiration continued off and on until 8 h. 26 m. 40 s. Needle in the heart afterwards moving slightly, but rhythmically. The trachea was opened and artificial respiration performed by the bellows method for a few minutes, but with no result.

November 22nd.—No. 110.

Medium-sized female monkey, weight 11½ lbs. (has varicose veins on abdomen). Into chloroform box at 8 h. 51 m. Fallen down at 8 h. 54 m. 15 s. On the table at 8 h. 56 m. 45 s. Temperature in rectum 101.4 F. Artery ligatured at 9 h. 10 m. 5 s. Canula inserted 9 h. 12 m. 45 s. Loops under both vagi. Breathing stopped at 9 h. 23 m. 50 s. Artificial respiration at once and until 9 h. 24 m. 50 s., when breathing became natural again. Stopped breathing again at 9 h. 27 m. and artificial respiration performed for some time but without success. Temperature after death 100.8 F. Post-mortem—The large bronchi and trachea were filled with blood, and there was a large patch of bloody effusion in the posterior lobe of one of the lungs.

November 22nd.—No. 111.

Monkey, weight 10½ lbs., chloroformed in the box 9 h. 43 m. 50 s. Monkey fallen down at 9 h. 48 m. 45 s. On the table 9 h. 50 m. 40 s. Artery ligatured and canula inserted. Connexion with manometer at 10 h. 13 m. 30 s. Four Ludwig and two Fick tracings.

Observations.

- H. M. S.
 A. 10 14 30.—Ordinary chloroform administration on several occasions.
 B. 10 20 40.—Small incision into the abdomen and tying a small tube into the colon (erroneously written "stomach" on the tracing).
 C. 10 51 0.—Injection of two doses of half a grain of tartar emetic into the colon; struggling.
 D. 11 15 0.—Exposing and destroying the left splanchnic cord and plexus, during which proceeding the animal was detached from the manometer.
 E. 11 34 20.—Pushing chloroform until respiration had almost stopped.
 F. 12 8 20.—Application of hot and afterwards cold cloths to the body.
 G. 12 14 40.—Placing a clean cap over the nose.
 H. 12 12 30.—Holding ammonia before the nose.
 I. 12 20 0.—Pushing chloroform until respiration ceased.
 J. 12 27 0.—Artificial respiration.
 K. 12 31 20.—Exposing the jugular vein.
 L. 12 36 0.—Injection of ammonia, 5 minims of strong ammonia diluted with 20 minims of water into the jugular.
 M. 12 40 0.—Pushing chloroform finally until death resulted. The decline of blood-pressure was unusually gradual. The temperature in the rectum had fallen below 95 F. for some time before the end of the experiment.

N.B.—Readings marked "C" were taken with a second Fick instrument made by the Cambridge Co.

To test the effect of shock due to vaso-motor change rather than affection of the heart Goltz's experiment on the frog was repeated on three dogs. In one there was slight lowering of pressure which was not extensive, and in the others no effect was produced at all. Other operations, which seemed likely to produce shock, such as violent blows upon the testicle, were singularly devoid of effect. Failing to lower the blood-pressure by any of these methods, recourse was had to section of the splanchnics, but the low condition of blood-pressure this produced appeared, like stoppage of the heart from vagus irritation, to be a source of safety rather than a danger during chloroform administration. In this connexion Experiment No. 111 may be studied. There was not much external hæmorrhage, but the splanchnics were divided—a proceeding which, as is often said, bleeds the animal into his own vessels. The pressure was after this extremely low, but chloroform was repeatedly given, and

various other actions taken, and then chloroform had to be pushed on a saturated sponge enclosed in a cap for eleven minutes before respiration ceased.

November 22nd.—No. 112.

Temperature of the room 24½ Cent. Into chloroform box at 2 h. 41 m. 19 s. Fallen down at 2 h. 44 m. 47 s. On the table at 2 h. 46 m. Observed to have stopped breathing at 2 h. 46 m. 10 s. Artificial respiration until he was pronounced "dead" at 3 h. 2 m. Needle in the heart faintly moving at 2 h. 54 m. 30 s. Post-mortem showed all the signs of asphyxia.

There were thus three accidental deaths in the course of this one day, November 22nd, which it may be noted was exceptional in being a wet day, and was characterised by constant blunders and mistakes committed by every one engaged in the experiments and in every department (*vide*, for example, the blunders and smudges on the tracings in No. 111) as well as in the administration of chloroform.

November 22nd.—No. 113.

Temperature of the room 24½ Cent. Pariah dog. Weight 38 lbs. Into the chloroform box at 3 h. 5 m. 30 s. Placed on the board at 3 h. 8 m. 10 s. and kept quiet with chloroform. Artery ligatured at 3 h. 19 m. 10 s. Canula inserted at 3 h. 23 m. 40 s. Temperature in the rectum 100.4 F. at 3 h. 23 m. 45 s. Connexion with manometer at 3 h. 30 m. Three Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 3 30 0.—Chloroform administration and struggling (the trace is imperfect on account of the drum sticking).
B. 3 32 20.—Cessation of respiration and artificial respiration.
C. 3 33 25.—Division of the right and then the left vagus.
D. 3 38 0.—Pushing chloroform again until respiration stopped and restoration by artificial respiration.
E. 3 39 30.—Exposing the femoral vessels and repetition of D.
F. 3 51 0.—Ligature of femoral artery and vein.
G. 4 3 10.—Hæmorrhage to 170 cc. from the femoral artery and chloroform again.
H. 4 14 20.—Transfusion of saline solution into femoral vein 250 cc. in two doses.
I. 4 20 30.—Pushing chloroform again as in D.
J. 4 28 55.—Hæmorrhage again 250 cc. of blood taken.
K. 4 31 0.—Repetition of the transfusion and pushing chloroform as before.

Failure to restore the animal in spite of artificial respiration and transfusion of ammonia. Temperature in the rectum gradually fell to 96.3 F. at death. Post-mortem—Right heart filled with coagula.

November 23rd.—No. 114.

Rabbit into cubic foot box with paper saturated with chloroform at 7 h. 41 m. 10 s. Breathing, which was held at first, rapid at 7 h. 42 m. Fallen on its side at 7 h. 42 m. 30 s. Breathing stopped at 7 h. 42 m. 50 s. Stopped chloroform and performed artificial respiration at 7 h. 43 m. Convulsions at 7 h. 44 m. Pupils gradually dilating. Convulsions nearly ceased at 7 h. 45 m. Came round at 7 h. 46 m. No connexion was made with the recording apparatus, and there is therefore no tracing.

November 23rd.—No. 115.

Monkey. Weight 93 lbs. Temperature of the room 23 Cent. Into chloroform box at 7 h. 49 m. 10 s. Fallen down at 7 h. 52 m. 10 s. Placed on the board at 7 h. 53 m. and kept quiet with chloroform. Left carotid exposed and a loop placed under the right vagus. Operation to expose the splanchnics commenced at 8 h. 11 m. 30 s. Left splanchnic ligatured at 8 h. 18 m. and the plexus excised. Artery ligatured at 8 h. 24 m. 5 s. Canula inserted at 8 h. 29 m. 10 s. Temperature in rectum 97 F. Connexion with manometer at 8 h. 37 m. 40 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 8 38 45.—Administration of chloroform; struggling.
B. 8 44 0.—Administration of ether on a cap.
C. 8 46 50.—Asphyxia from the trachea becoming obstructed with fluid.
D. 8 59 10.—Introduction of needle into the heart.
E. 9 2 50.—Pulling and cutting the right vagus.

The temperature in the rectum is noted from time to time on the Ludwig tracings. At 9 h. 5 m. the experiment was brought to an end by the canula cutting through the artery, and eventually the animal was killed with chloroform.

(After the manometer experiment was closed the convulsions of the brain were exposed, but stimulation failed to give any result.)

November 23rd.—No. 116.

Monkey, weight 12½ lbs., given two grains of morphine under the skin of the thigh at 10 h. 1 m. Tied on to the dog-board at 10 h. 19 m. and two grains more morphine injected at 10 h. 20 m. 10 s. Quite wide awake at 10 h. 30 m. 10 s. Given a little chloroform at 10 h. 35 m. 30 s., when he was slightly under the influence of morphine and kept quiet with chloroform. Loop under both vagi. Right pupil slightly dilated. Left contracted at 10 h. 48 m. Artery ligatured at 10 h. 50 m. 45 s. Canula inserted at 10 h. 53 m. 15 s. Right pupil then widely dilated. Temperature 100.6 F. Connexion with manometer at 11 h. 8 m. Two Ludwig and two Fick tracings.

Observations.

- H. M. S.
A. 11 12 30.—Ordinary chloroform administration.
B. 11 17 0.—Ligature of the femoral artery and vein.
C. 11 29 25.—Hæmorrhage from femoral artery.
D. 11 31 10.—Transfusion of saline solution and ammonia (5 minims liquor ammoniæ fort. to 25 ounces of saline). Respiration stopped at 12 h. 11 m. 30 s., but after continuous artificial respiration the animal gave one gasp at 12 h. 22 m. 30 s. and began breathing naturally at 12 h. 23 m. 30 s. During almost the whole of this time the manometer tracing was interrupted by clots in the tubes.
E. 11 55 0.—Ether inhalation at short intervals.
F. 12 14 30.—Needle into the heart.

H. M. S.

- G. 12 30 35.—Small incision into abdomen, and injection of spirits of ammonia into the stomach.
H. 12 35 48.—Pushing ether.
I. 12 37 0.—Pushing chloroform until death.
(The manometer tracing was again interrupted before the end of the experiment.)

November 25th.—No. 117.

Temperature of the room 23 Cent. Unusually large brindled dog. Weight 38½ lbs. Into the chloroform box at 7 h. 28 m. 10 s. Placed on the table at 7 h. 36 m. 20 s., and kept quiet with chloroform. Left carotid ligatured at 7 h. 46 m. 10 s. Canula inserted at 7 h. 49 m. 15 s. Temperature in rectum 101.4 F. Connexion made with the manometers at 7 h. 56 m. 15 s. Four Ludwig and six Fick tracings showing the effect of pushing chloroform during irritation of the entire right vagus on several occasions. In one of these the irritation of the vagus was kept up continuously for more than eight minutes, and the chloroform administration for seven minutes, and the animal recovered without artificial respiration. At another time when irritation accidentally failed on account of defect in the electrodes, the animal was with difficulty restored after chloroform had been pushed for one minute. Death eventually ensued after prolonged irritation of the vagus, together with pushing chloroform and artificial respiration to ensure the chloroform entering the lungs freely.

Observations.

- H. M. S.
A. 7 56 0.—Chloroform on an ordinary cap.
B. 8 1 40.—Electrical irritation of the right vagus. Inhibition of the heart is seen in Fick 4.
C. 8 2 50.—Chloroform pushed to stoppage of respiration; artificial respiration; irritation of right vagus during revival (*vide* Fick 5).
D. 8 9 10.—Irritation of right vagus, chloroform commenced at 8 h. 9 m. 20 s. and pushed to stoppage of respiration (8 h. 10 m. 25 s.), chloroform stopped at 8 h. 11 m. 50 s. Irritation of the vagus stopped at 8 h. 12 m. 10 s. Natural breathing at once recommenced spontaneously. Observation repeated in the same way and with the same result at 8 h. 15 m. 30 s. (*vide* Fick 6). Observation repeated for a much longer time at 8 h. 28 m. 30 s. The chloroform and irritation of the vagus were kept up from 8 h. 28 m. 30 s. to 8 h. 36 m. 40 s. (*vide* Fick 9, 10, 11, 12, 13, and 14). Directly the irritation was stopped the pressure rose, showing that very little chloroform had hitherto been conveyed to the nerve centres, and that there is no danger in mere lowering of the blood-pressure. The pressure fell again at 8 h. 37 m. 0 s. This evidently occurred from the inhibition of the heart having been stopped. The residual chloroform in the lungs was then rapidly taken up and produced its ordinary effect. (Compare with Observation D in Experiment 64.)
E. 8 52 30.—Chloroform administration for one minute and twenty-five seconds. Respiration stopped at 8 h. 53 m. 55 s. Artificial respiration was then performed for two and a half minutes, from 8 h. 54 m. 0 s., and natural breathing recommenced at 8 h. 57 m. 0 s.
F. 9 2 20.—Electrical irritation of vagus; the stimulation was effective at first (*vide* Fick 19), but wore off and when chloroform was administered at 9 h. 3 m. 0 s. it had almost ceased, and the full effects of the anæsthetic were quickly developed. Respiration stopped at 9 h. 4 m. 0 s. and the chloroform cap was removed at 9 h. 4 m. 15 s. Though the anæsthetic had only been administered for little over a minute, the animal was restored with great difficulty by artificial respiration, which was kept up for six minutes and thirty-five seconds before natural breathing returned at 9 h. 11 m. 0 s.
G. 9 19 20.—Chloroform pushed again with irritation of the vagus at the same time. In this observation the stimulation did not become effective till after the respiration stopped. The breathing ceased at 9 h. 20 m. 20 s. The irritation was stopped at 9 h. 21 m. 25 s. and the chloroform cap was removed at 9 h. 21 m. 35 s. Breathing recommenced spontaneously at 9 h. 23 m. 50 s., but was not fully established till 9 h. 25 m. 15 s. During this time there were some remarkable fluctuations of the blood-pressure, the falls being probably due to residual chloroform being taken up from the lungs, alternating with rises due to elimination of the anæsthetic from the lungs when the animal breathed (*vide* Ludwig III. at 9 h. 22 m. 0 s., 9 h. 24 m. 0 s., and 9 h. 25 m. 0 s.).
H. 9 31 25.—This observation consisted in prolonged irritation of the vagus from 9 h. 30 m. 25 s. to 9 h. 41 m. 50 s. and the administration of chloroform by artificial respiration from 9 h. 31 m. 45 s. to 9 h. 39 m. 50 s. The animal died, but the heart did not stop finally till 9 h. 44 m. 30 s. This observation would have been more satisfactory if the vagus irritation had been kept up until all the residual chloroform in the lungs had been got rid of by artificial respiration.

The whole experiment is most instructive, as it, like Observation D in Experiment No. 64, proves that inhibition of the heart's action by the vagus prevents the fatal effects of chloroform poisoning and benefits the heart. The animal in Experiment 117 was put into a condition of extreme danger, from which it could only be restored by means of artificial respiration, by inhalation of chloroform for little over one minute (*vide* Ludwig I., 8 h. 3 m. 0 s., and Ludwig II., 8 h. 53 m. 30 s.). The same animal recovered spontaneously and readily after five minutes of chloroform inhalation, with inhibition of the heart produced by electrical stimulation of the vagus. At 8 h. 29 m. 20 s.

(vide Ludwig II.) chloroform was pushed for seven minutes during continued irritation of the vagus, and the animal came round without artificial respiration. The danger really begins in these cases when the irritation is discontinued or fails to inhibit the heart, and thus enables the residual chloroform in the lungs to be rapidly absorbed and thrown into the system (vide Ludwig III., 9 h. 22 m. 0 s. to 9 h. 25 m. 0 s.).

November 25th.—No. 118.

Monkey (Macacus). Weight 11 lbs. Temperature of the room 24.5 Cent. Into chloroform box at 10 h. 27 m. 27 s. Fallen down at 10 h. 32 m. 25 s. Placed on table at 10 h. 32 m. 20 s. and kept quiet with chloroform. Temperature in rectum 104.4 F. at 10 h. 42 m. 30 s. Artery ligatured at 10 h. 50 m. 50 s. Canula inserted at 10 h. 52 m. 30 s. Both vagi looped with a loose ligature. Connexion made with manometer a few seconds before 10 h. 58 m. Two Ludwig and three Fick tracings.

Observations.

- H. M. S.
A. 10 58 55.—Ordinary chloroform administration with violent struggling.
B. 11 3 20.—Irritation of the entire left vagus.
C. 11 33 40.—Irritation of the left vagus and pushing chloroform at the same time on two occasions.
D. 11 41 40.—Chloroform administration with struggling.
E. 11 42 20.—Imperfect irritation of the right vagus and pushing chloroform.

The tracing was interrupted by clotting in the tubes just as the irritation of the vagus and chloroform administration were stopped. The animal breathed spontaneously for a few seconds, but then finally ceased breathing and died.

November 25th.—No. 119.

Temperature of the room 25 Cent. Large pariah, weight 30 lbs., that has had phosphorus on the previous two days, one grain each day, and had been chloroformed in the morning by Dr. Rustomji, and is extremely feeble. Into chloroform box at about 2 h. 19 m. Fallen down at 2 h. 21 m. Placed on the table at 2 h. 22 m. 10 s. and kept quiet with chloroform. Respiration very feeble and artificial respiration began at 2 h. 24 m. 45 s. Breathing better at 2 h. 25 m. 40 s. (The dog was so feeble generally that it was not necessary nor advisable to the him down on the board in the usual way.) Temperature 99.8 F. in the rectum at 2 h. 29 m. Connexion made with manometer at 2 h. 41 m. 20 s. Four Ludwig and three Fick tracings.

Observations.

- H. M. S.
A. 2 42 40.—Chloroform administration; holding breath and gasping; placing thermometer in the rectum; struggling.
B. 3 12 55.—Irritation of right vagus and pushing chloroform until respiration stopped; with spontaneous recovery (vide Fick 5).
C. 3 23 0.—Irritation of right vagus and pushing ether (vide Fick 8).
D. 3 38 20.—Pushing chloroform, and after the blood pressure had fallen, irritating the vagus.
E. 3 43 20.—Artificial respiration.
F. 3 53 30.—Tracheotomy.
G. 3 55 0.—Artificial respiration by bellows apparatus attached to a tube in the trachea.
H. 4 10 0.—Blowing ether by means of this apparatus directly into the trachea.
I. 4 13 40.—Introduction of chloroform by means of a Junker's inhaler introduced through the tracheal tube down to the bronchi, and pushing it until death resulted. Post-mortem.—Temperature 97.6 F. Heart pale and rather friable. Liver very pale and soft.

November 25th.—No. 120.

Rabbit that had 5 minims of liquor atropine an hour before. Into chloroform box, 1 cubic foot in area, at 4 h. 23 m. 30 s. Drowsy and vessels of the ear dilated at 4 h. 29 m. Fallen on its side and whining at 4 h. 29 m. 30 s. Breathing stopped at 4 h. 30 m. Taken out at once and artificial respiration commenced, but this was of no avail though continued until 4 h. 38 m.

November 26th.—Nos. 121 and 122.

No. 121. Rabbit. 5 minims of solution of atropine sulphate injected into the thigh at 7 h. 10 m. 20 s.

No. 122. Rabbit that has not had atropine.—

	No. 121.	No. 122.
	H. M. S.	H. M. S.
Both into chloroform at ...	7 25 15	7 25 15
Fell down on side at ...	7 27 5	7 27 5
sat up again at ...	7 27 30	Continued
Struggling at ...	7 27 40	on his side.
Crying at ...	...	7 28 45
Stertorous breathing at ...	...	7 29 7
Fundus of the eye bluish at ...	...	7 29 30
Beating time with feet at ...	7 30 15	7 30 15
Stopped breathing at ...	...	7 31 5
Taken out of box and artificial respiration commenced at ...	...	7 31 30
Breathing naturally at ...	...	7 32 30
Cornea sensitive at ...	...	7 32 45
Taken out of box though still breathing at ...	7 33 10	...
Cornea sensitive at ...	7 34 20	...
Excited struggling at ...	7 35 0	...

At 7 h. 38 m. the pupils of 122 were more dilated than the pupils of 121.

November 26th.—Nos. 123 and 124.

	No. 123.	No. 124.
Two small monkeys, weight ...	7 lbs.	8½ lbs.
	H. M. S.	H. M. S.
Into chloroform in a cubic foot box at ...	7 53 0	7 53 0
Fallen down at ...	7 56 30	7 56 30
Struggling at ...	...	7 56 40

	H. M. S.	H. M. S.
Taken out of box at ...	7 57 40	7 57 40
Chloroform to keep quiet at ...	7 59 40	7 59 40
"Under." Stopped chloroform at ...	8 0 30	8 0 45
More chloroform again at ...	8 1 53	8 6 32
"Under." Stopped chloroform at ...	8 2 30	8 7 50
More chloroform, 3rd time on inhaler in front of tracheal tube at ...	8 7 50	8 10 30
"Under." Stopped chloroform at ...	8 7 53	8 11 52
More chloroform, 4th time at ...	8 11 10	8 21 20 Do.
"Under." Chloroform stopped at ...	8 11 50	8 23 10
More chloroform, 5th time at ...	8 16 50	...
"Under" at ...	8 18 0	...
Opened trachea at ...	8 9 0	8 7 35
Canula inserted at ...	8 9 5	8 8 45
Re-inserted, having slipped out at ...	8 20 7	...
Attached to the bellows artificial respiration apparatus, which was so arranged as to blow air through a separate bottle into each monkey at ...	8 23 27	8 23 27
Opening the thorax at ...	8 24 30	8 24 0
Heart exposed at ...	8 26 30	8 27 0
Ether in bottle at ...	...	8 32 15
Chloroform in bottle at ...	8 32 30	...
Heart stopped ...	8 39 0	... 7

November 26th.—No. 125.

Monkey (medium-sized Macacus). Weight 11½ lbs. Into chloroform box at 9 h. 20 m. Fallen down at 9 h. 29 m. 15 s. Placed on board at 9 h. 29 m. 30 s. Kept quiet with chloroform. Trachea opened at 9 h. 35 m. 30 s. Tube inserted at 9 h. 36 m. Artificial respiration kept up by bellows apparatus and chest opened. Attempt to connect with Roy's cardiograph failed. Ether began at 10 h. 22 m. 10 s. Heart contracting very feebly. Fresh air 10 h. 24 m. 30 s. Heart just moving and no more. Flickering until 10 h. 40 m.

November 26th.—No. 126.

Monkey small, Weight 4½ lbs. Into box and chloroform given at 10 h. 36 m. 30 s. Fallen down at 10 h. 40 m. 45 s. Trachea opened at 10 h. 45 m. 5 s. and canula inserted. Kept quiet with chloroform. Opening thorax at 11 h. 6 m. 15 s. with artificial respiration by bellows apparatus. Heart exposed at 11 h. 8 m. 30 s. 5 cc. of ether into the bottle of the apparatus. Animal "quite out" at 11 h. 11 m. Cornea insensitive at 11 h. 11 m. 50 s. Heart's action very rapid at 11 h. 13 m. 50 s., but still acting vigorously. Chloroform, same quantity, at 11 h. 16 m. 45 s. (all the ether had evaporated). Ventricle stopped at 11 h. 17 m. 45 s. Heart flickering at 11 h. 19 m. Lungs no longer contracting at 11 h. 20 m. 30 s. All right again at 11 h. 21 m. 50 s. Lungs not distending at 11 h. 24 m. owing to apparatus breaking down. 3½ cc. of chloroform remained in the bottle.

November 26th.—No. 127.

Small monkey. Weight 4½ lbs.

November 26th.—No. 128.

Small monkey. Weight 4½ lbs.

	H. M. S.		H. M. S.
Into chloroform box 1 cubic foot capacity.	2 32 0	Into chloroform box 1 cubic foot capacity.	...
Still standing and licking the glass.	2 33 45	Fallen down.	...
More chloroform into the box ...	2 35 45	Taken out of box and tied on to board.	...
Fallen down ...	2 37 0		...
Taken out of box and tied on board.	2 37 10		...
More chloroform in ordinary cap	2 38 0	Tracheotomy commenced.	...
Stopped getting chloroform ...	2 39 41		...
Tracheotomy commenced ...	2 40 10		...
	2 40 20	Trachea opened.	...
	2 40 35		...
	2 41 5	Glass tube inserted.	...
	2 41 53	Having chloroform (cap held before tube).	...
	2 43 3	Stopped chloroform.	...
More chloroform ...	2 43 37		...
Stopped chloroform ...	2 43 58		...
More chloroform ...	2 45 38		...
Stopped again ...	2 46 5		...
Trachea opened ...	2 47 30		...
	2 49 17	More chloroform.	...
Glass tube into trachea ...	2 50 27		...
	2 51 4	Stopped chloroform.	...
More chloroform on ordinary cap in front of tube.	2 51 35		...
Stopped chloroform ...	2 52 43		...
Tube slipped out of trachea ...	2 53 10		...
	2 53 45	More chloroform.	...
	2 54 15	Stopped chloroform.	...
More chloroform by mouth ...	2 54 40		...
Stopped chloroform ...	2 55 10		...
Glass tube inserted again ...	2 55 31		...
More chloroform ...	2 55 52		...
Stopped chloroform ...	2 56 28		...
	2 57 43	More chloroform.	...
More chloroform ...	2 58 54		...
Stopped chloroform ...	2 59 30	Stopped chloroform.	...
Connected with the bellows-artificial respiration apparatus.	3 0 0	Connected with the bellows-artificial respiration apparatus.	...
Opening thorax ...	3 0 21	Opening thorax.	...
Chloroform through the bellows ...	3 0 44	Chloroform through the bellows.	...
	3 1 52	Heart exposed.	...
Heart exposed ...	3 2 4		...

7 Owing to a kink in the tubes No. 124 was killed by asphyxia; his heart only flickering or very feebly contracting when it was first exposed, but it continued to do so until 10 h. 48 m. with still a faint contraction of one corner of the auricle at 11 h. 30 m.

Struggling	H. M. S.	Struggling.
	3 2 25	Lungs not expanding.
Lungs expanding freely	3 3 10	Expanding imperfectly.
	3 3 20	Lungs expanding freely.
Chloroform into the bottle	3 4 50	Ether into the bottle.
Heart distinctly feeble	3 5 10	
	3 5 30	Heart very rapid.
	3 5 35	Jerk action of the dia-
	3 5 38	phragm.
	3 7 7	Needle into heart.
Needle into heart	3 7 20	More ether into bottle.
Another needle into heart... ..	3 7 30	Cornea sensitive.
	3 8 45	
Lungs not expanding	3 9 40	
Heart stopped	3 12 5	
(Post-mortem showed clot at the bifurcation of the bronchi).	3 14 45	Ether completely evaporated.
	3 15 5	More ether into bottle.
	3 17 30	Needle barely moving.
	3 27 45	Stopped.

November 26th.—No. 129.

Small monkey. Weight 3½ lbs.	H. M. S.	Small monkey. Weight 4½ lbs.
Into chloroform box	3 31 32	Into chloroform box.
Drunk	3 34 52	Drunk.
Fallen down	3 34 10	
	3 34 22	Fallen down.
Taken out of box	3 35 7	Taken out of box.
	3 35 35	More chloroform.
More chloroform	3 36 0	Stopped chloroform.
Stopped chloroform	3 36 32	More chloroform.
	3 36 57	
More chloroform	3 37 24	Stopped chloroform.
	3 37 58	Commenced tracheotomy.
Commenced tracheotomy	3 38 40	
	3 38 50	
Stopped chloroform	3 39 0	
Trachea opened	3 39 48	
Glass tube inserted	3 40 8	
	3 40 10	Stopped chloroform (commencement not noted).
More chloroform	3 40 45	
Stopped chloroform	3 42 0	
More chloroform	3 43 45	
Stopped chloroform	3 44 47	
More chloroform	3 46 30	
	3 46 50	Tube inserted into trachea.
Stopped chloroform	3 47 25	
	3 51 0	More chloroform.
More chloroform	3 51 52	
Stopped chloroform	3 52 27	
More chloroform	3 53 15	
Stopped chloroform	3 53 41	Stopped chloroform.
Connected with artificial respiration apparatus.	3 55 0	
Cornea sensitive	3 55 15	Connected with apparatus; cornea sensitive.
Chloroform through bellows	3 56 0	Chloroform through bellows.
Ten minims chloroform into bottle.	3 57 25	
	3 57 43	10 minims chloroform into bottle.
Cornea insensitive	3 58 0	Cornea sensitive.
Opening chest	3 58 15	Opening chest.
Heart fully exposed	3 59 10	
Lungs expanding better	4 0 0	
	4 0 20	Heart exposed.
5 cc. ether into bottle	4 2 24	
	4 2 37	5 cc. chloroform into bottle.
Needle into heart	4 2 57	
Heart beating rapidly, communicating movements to the abdominal wall.	4 3 30	Heart very feebly beating.
	4 3 55	Needle into heart.
5 cc. more ether	4 8 0	
	4 8 18	5 cc. more chloroform.
Needle moving less vigorously but distinctly.	4 8 40	Needle barely moving.
	4 10 0	Very slightly moving, if at all.
	4 10 55	Absolutely not moving.
Needle moving slowly but steadily. More ether.	4 12 3	After opening pericardium heart again flickered.
Heart stopped... ..	4 12 20	
November 27th.—No. 132, 3½ lbs. Medium-sized monkey.		No. 131, 3½ lbs. Medium-sized monkey.
Into chloroform box	8 24 20	Into chloroform box.
	8 26 0	Drooping.
More chloroform into box	8 27 18	More chloroform into box.
	8 27 47	Fallen against the side.
	8 28 50	Down and breathing stertorously.
	8 29 55	Taken out of box and tied on to a board.
Fallen down	8 30 10	
Taken down and tied on to a board.	8 31 8	
	8 31 32	More chloroform into the box.
	8 32 22	Stopped chloroform and commenced tracheotomy.
More chloroform	8 33 20	

Stopped chloroform and begin tracheotomy.	H. M. S.	Trachea opened.
	8 34 4	Tube inserted into trachea
	8 34 49	More chloroform.
	8 35 9	
Trachea opened	8 35 51	
Tube inserted	8 36 33	
Respiration stopped & artificial respiration.	8 36 55	
	8 37 45	
	8 38 5	Stopped chloroform.
	8 39 15	More chloroform.
	8 40 2	Stopped chloroform.
	8 43 20	
Pressure had probably been made on the chest by the operator, who had operated from below and covered the chest with his hands.		
No heart sound audible; needle into heart.	8 44 15	
Needle feebly moving; continue artificial respiration.	8 45 10	More chloroform; struggling.
Abandoned	8 46 23	Stopped chloroform.

No. 134.

Another medium-sized monkey. Weight 4 lbs.

Small monkey. Weight 4 lbs.	H. M. S.	Small monkey. Weight 4½ lbs.
Into chloroform box	8 51 3	Into chloroform box.
Still sitting up and looking about him.	8 52 46	More chloroform.
Leaning against the side	8 53 37	Stopped chloroform.
Still moving about	8 56 23	
Fallen down	8 57 58	
Taken out of box	8 58 5	
More chloroform on cap	8 59 0	
Chloroform stopped; tracheotomy begun.	9 1 25	More chloroform.
	9 1 52	Stopped chloroform.
Trachea opened	9 2 7	
Tube inserted	9 2 18	
More chloroform	9 3 9	
	9 3 29	More chloroform.
	9 3 50	Stopped chloroform.
Stopped chloroform	9 3 55	
Attached to bellows apparatus...	9 4 5	Attached to bellows apparatus.
	9 4 31	Opening thorax.
Commenced to open thorax and artificial respiration begun.	9 5 5	Artificial respiration begun.
A little chloroform into bottle	9 6 45	
	9 6 27	Heart exposed.
More chloroform into bottle ...	9 7 27	
"Over" and proceed with operation.	9 8 0	
Heart exposed... ..	9 8 57	
Pericardium opened	9 9 40	Chloroform into bottle.
	9 10 30	Quite over.
	9 10 35	Needle into heart.
	9 10 20	Bottle emptied.
	9 11 35	Needle taken out of heart.
Cornea sensitive	9 12 30	
	9 12 50	Ether into bottle 5 cc.
5 cc. chloroform into bottle ...	9 13 10	
Needle into heart	9 13 30	Needle into heart.
	9 15 5	5 cc. more ether into bottle.
5 cc. chloroform	9 15 45	
	9 17 0	Heart beating rapidly.
	9 17 55	Ether all evaporated.
5 cc. chloroform	9 19 20	10 cc. more ether into bottle.
Left ventricle hardly acting; right better.	9 21 20	
	9 21 55	Pericardium removed.
Heart feebly flickering	9 22 40	
	9 24 34	8 cc. ether into bottle.
	9 29 43	Another needle into heart.
Needle absolutely still... ..	9 38 0	
	9 39 55	Connexion between needle and a time-marker (vide tracing)
	9 44 15	More ether into bottle.
	8 51 5	Artificial respiration stopped (after which it made spontaneous respiratory movements about every fourth second).
	10 0 0	Artificial respiration commenced. He came round and breathed spontaneously again (vide tracing II.)
	10 24 0	Artificial respiration begun again.
	10 27 0	Chloroform into bottle.
	10 37 0	Needle taken out. Heart still beating.
	10 48 30	Finally stopped, but still remained irritable, so that it began beating again when needle was put into it.

November 27th.—No. 133.

Horse t.brown and given chloroform on a nose-bag at 10 h. 50 m. Loop under right vagus at 10 h. 55 m. 45 s. Right carotid ligatured at 10 h. 57 m. 40 s. Canula inserted at 11 h. 1 m. Connexion with manometer at 11 h. 17 m. 55 s. while horse was on the floor. (He was afterwards, 11 h. 42 m. 30 s., raised on to the table.)

Two Ludwig and two Fick tracings.

Observations.

- A. Ordinary chloroform administration.
 B. Slight struggling.
 C. Pushing chloroform until respiration stopped; death resulted in spite of long-continued artificial respiration.

Repeated attempts were made to irritate the vagus, but they failed as the nerve was never exposed.

November 27th.—No 135.

Medium-sized monkey. Weight 13 lbs. Temperature of room 23½ Cent. Into chloroform box at 2 h. 22 m. 35 s. Placed on the table at 2 h. 27 m. 42 s. and kept quiet with chloroform. Temperature in rectum 102.6 F. at 2 h. 37 m. 30 s. Artery ligatured at 2 h. 45 m. 25 s. Canula inserted at 2 h. 48 m. 10 s. Loop under both vagi. Connexion made with manometer at 2 h. 59 m. 50 s. Three Ludwig and three Fick tracings.

Observations.

- A. Ordinary chloroform administration and struggling.
 B. Double ligature and division of the right vagus.
 C. Irritation of the central, and
 D. Peripheral end of the vagus.
 E. Injection of 10 grains of chloral into the peritoneum, and afterwards irritation of the central and peripheral end of the right vagus.
 F. Exposure and ligature of the femoral artery.
 G. Opening the trachea and tying a small glass tube into it.
 H. Closure of the tracheal tube so as to produce almost complete asphyxia.
 I. Pumping chloroform vapour into the closed tube by means of Junker's inhaler while the respirations are still embarrassed and consequent speedy death.

While the chest was being opened air suddenly rushed in, and it was thought that spontaneous respiration was going to recommence, but there was no real spontaneous movement. After death chloroform was injected with much force into the femoral artery and produced complete rigidity of the limb.

November 25th.—No. 136.

Goat, young male, weight 16 lbs. Into chloroform box at 10 h. 48 m. 20 s. Fallen down and taken out of box at 10 h. 59 m. 20 s. Placed on the board and kept quiet with chloroform. Loop under both vagi. Ligatured the left carotid at 11 h. 9 m. 26 s. Canula inserted at 11 h. 11 m. 47 s. Temperature in rectum 102.6 F. at 11 h. 18 m. 20 s. Connexion with manometers at 11 h. 19 m. 20 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 11 11 30.—Ordinary chloroform administration; holding breath.
 B. 11 25 10.—Pushing chloroform until respiration had almost ceased.
 C. 11 30 0.—General convulsions; respiration ceased at 11 h. 28 m. 20 s.
 D. 11 30 30.—Artificial respiration was commenced some minutes after the respiration had entirely ceased and failed to restore the animal. The case was complicated by a very distended stomach and the fact that the trachea was filled with fluid at an early stage. It was thought that some of the contents of the stomach found their way into the air passages during the convulsions or even before they occurred. A needle was inserted into the heart at 11 h. 34 m. 0 s. and moved rhythmically until 11 h. 41 m. 40 s.

November 28th.—No. 137.

Goat, young male, weight 15½ lbs. Into chloroform box at 11 h. 46 m. 43 s. Fell down at 12 h. 2 m. 30 s. and taken out of box, but still quite sensitive. More chloroform from time to time to keep it under. Holds its breath like the other goat whenever chloroform is given. Temperature in rectum at 12 h. 8 m., 103.6 F. Artery ligatured at 12 h. 11 m. 15 s. Canula inserted at 12 h. 12 m. 50 s. Connexion with manometer at 12 h. 16 m. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 12 18 10.—Ordinary chloroform administration showing the effect on the tracing of holding the breath, and of irregular jerking respiration.
 B. 12 25 40.—Irritation of the left vagus nerve (*vide* Fick 4).
 C. 12 37 30.—Pushing chloroform and irritating the left vagus. Pulse reduced from 80 to 20 (*vide* Fick 6).
 D. 12 45 40.—The same, only for a much longer time, after which the animal died in spite of artificial respiration, which, however, for some reason was never efficient, no air passing in and out of the chest. Pulse reduced from 80 to 48.

On opening the chest a large quantity of blood was found in the left pleural cavity.

Remarks.—Tracing No. 137 shows the effect of irregular breathing in chloroform administration, causing a corresponding irregularity of the blood-pressure. It also shows the effect of electrical irritation of the vagus, producing complete stoppage of the heart for 17 seconds without any bad result. This tracing shows the safeguard effect of slowing the circulation by irritation of the vagus. The first time this was done during chloroform administration it reduced the pulse from 80 to 20 a minute, and the chloroform had no effect. The second time the pulse was only reduced from 80 to 48; the chloroform inhalation was kept up much longer, and gradual death ensued.

November 29th.—No. 138.

Temperature of room 20 Cent. Cat, weight 6½ lbs. Into chloroform at 7 h. 58 m. 5 s. More chloroform into the box at 8 h. 1 m. 55 s. Struggling at 8 h. 2 m. Fallen down at 8 h. 2 m. 15 s. Tied on to rabbit board and given chloroform from time to time to keep it under. Temperature in the rectum 106 F. at 8 h. 9 m. 45 s. and artery ligatured. Connexion with manometer at 8 h. 1 m. 25 s.

Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 8 4 30.—Administration of ether on a cap.
 B. 8 34 0.—Struggling.
 C. 8 44 30.—Pushing ether until respiration had almost ceased and only occasional gasping continued.
 D. 8 53 30.—Pushing ether with the cap covered with mackintosh until death ensued.

In this and the next experiment the respiration was registered by a system of Marey's tambours connected with a pin in the chest wall, the marker running below the manometer tracing.

November 29th.—No. 139.

Small cat, weight 6½ lbs. Chloroform given at 9 h. 29 m. 20 s. Fallen down at 9 h. 31 m. 45 s. Placed on the table at 9 h. 35 m. 40 s. During the operation of exposing the carotid the cornea was quite insensitive, but there was whining respiration. Artery ligatured at 9 h. 40 m. 50 s. Canula inserted at 9 h. 42 m. 20 s. Connexion with manometer at about 9 h. 50 m. 30 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 9 51 50.—Ordinary chloroform administration.
 B. 9 58 50.—Pushing chloroform until death ensued.
 The trace was interrupted just before the end by clots in the tube.

November 29th.—No. 140.

Moderate-sized monkey, weight 11½ lbs. Temperature of the room 21 Cent. Into chloroform in a cubic foot box at 10 h. 42 m. 15 s. Fallen against the side of the box at 10 h. 47 m. 20 s. A little more chloroform into box at 10 h. 48 m. 45 s. Down at 10 h. 49 m. 10 s. Eyes still blunking. Taken out of box at 10 h. 50 m. 20 s. and kept quiet with chloroform. Temperature 103 F. in rectum. Canula inserted into carotid 11 h. 5 m. 30 s.

One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 11 12 40.—Ether administration on a cap covered with a small piece of mackintosh which failed to keep the animal thoroughly under, though the cornea was insensitive, struggling occurring when a pin was thrust into the chest.
 B. 11 20 35.—Ether administration *plus* asphyxia by enveloping the head completely in mackintosh.
 C. 11 27 50.—Asphyxia by the same means without ether.
 D. 11 32 20.—Pushing ether *plus* asphyxia until death resulted.
 The trace was interrupted before the death of the animal by a clot in the tubes

November 29th.—No. 141.

Large goat, weight 66 lbs. Chloroformed by a nose-bag while standing at 2 h. 18 m. 51 s. Thrown down at 2 h. 19 m. 50 s. Cornea insensitive at 2 h. 20 m. 40 s. and chloroform stopped, the animal lying quite quiet while being tied down on to the table. Some salivation. Cornea sensitive at 2 h. 22 m. 40 s. More chloroform at 2 h. 23 m. 10 s. Cornea insensitive at 2 h. 25 m. 30 s. and chloroform stopped. Left carotid ligatured at 2 h. 27 m. 40 s. More chloroform at 2 h. 31 m. 28 s. Stopped chloroform at 2 h. 33 m. 3 s. More chloroform at 2 h. 35 m. 48 s. Stopped chloroform at 2 h. 36 m. 35 s. More chloroform at 2 h. 38 m. 50 s. Canula inserted into the artery at 2 h. 41 m. Stopped chloroform at 2 h. 41 m. 52 s. More chloroform at 2 h. 43 m. 31 s. Connexion made with manometers at 2 h. 44 m. 45 s.

One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 2 48 40.—Pushing chloroform until respiration ceased (*vide* Fick 3).
 B. 2 52 0.—Artificial respiration.
 C. 2 58 35.—Pushing chloroform until death ensued.
 D. 3 1 0.—Thrusting needle into the heart. The depressing effect of this operation is seen in the Ludwig tracing.

Post-mortem—Temperature 99.6 F.

November 20th.—No. 142.

Horse thrown and given chloroform at 3 h. 19 m. 45 s. very freely,* and while struggling chloroform had been stopped about one minute (?) when respiration was noticed to have stopped at 3 h. 23 m. 30 s. Artificial respiration commenced at once. No pulse at 3 h. 25 m. 45 s., and the animal was not restored to life.

November 29th.—No. 143.

(In the presence of His Highness the Nizam.)

Large goat, weight 70 lbs., given chloroform in a bag while standing at 3 h. 35 m. 55 s. Thrown down at once. Still bleating at 3 h. 37 m. 5 s. Stopped chloroform at 3 h. 37 m. 50 s., and while he was being carried and put on the table respiration stopped at 3 h. 38 m. Artificial respiration commenced at once; breathing naturally 3 h. 38 m. 55 s. Cornea sensitive. More chloroform at 3 h. 42 m. 25 s. Stopped at 3 h. 43 m. 2 s. Artery ligatured at 3 h. 43 m. 20 s. Temperature 102 F. in rectum. Temperature of the room 23½ Cent. Canula inserted at 3 h. 46 m. 15 s. More chloroform at 3 h. 47 m. 30 s. Connexion made with the manometers at 3 h. 50 m. 30 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 3 51 0.—Ordinary chloroform administration.
 B. 3 51 30.—Violent struggling (during which the marker was pushed over the top of the drum on several occasions by the violent oscillations in the pressure, and the tracings are consequently imperfect).
 C. 3 58 0.—Pushing chloroform until respiration ceased.
 D. 4 3 50.—Artificial respiration.

* A pint of chloroform was said to have been poured into the nose bag.

H. M. S.

- E. 4 5 10.—Pushing chloroform until respiration had ceased for some time, and failure to restore the animal by artificial respiration.
- F. 4 9 30.—The last ineffective gasps are shown on the Ludwig tracing.

November 29th.—No. 144.

(In the presence of His Highness the Nizam.)

Small horse, thrown at 4 h. 24 m. 15 s. Given chloroform in a nose-bag at 4 h. 26 m. 55 s. Struggling until 4 h. 28 m. 35 s. Operation to tie artery commenced at 4 h. 28 m. 55 s. Stopped chloroform at 4 h. 29 m. 35 s. More chloroform at 4 h. 30 m. 10 s. Stopped chloroform at 4 h. 31 m. 15 s. Loop under left vagus. Ligature left carotid artery at 4 h. 31 m. 50 s. More chloroform at 4 h. 33 m. 17 s. Stopped chloroform at 4 h. 35 m. 40 s. Canula inserted in 4 h. 36 m. More chloroform at 4 h. 37 m. 30 s. Stopped chloroform at 4 h. 39 m. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
- A. 4 44 0.—Ordinary chloroform administration.
- B. 4 47 10.—Irritation of left vagus three times, the second and third noticed on Fick readings 2 and 3.
- C. 4 50 30.—Pushing chloroform until respiration ceased.
- D. 5 0 0.—Artificial respiration. Pushing chloroform for 9 minutes with, at the same time, irritation of the left vagus for more than 7 minutes.

The respiration ceased after the irritation was discontinued, and the chloroform was then stopped. Pressure continued to fall and artificial respiration failed to restore the animal. The trace ends after 5 h. 11 m., but artificial respiration was continued until 5 h. 15 m. A needle then thrust into the heart did not move. Thorax opened and heart still at 5 h. 20 m.

November 29th.—No. 145.

(In the presence of His Highness the Nizam.)

Monkey, large sized female (Macacus). Into chloroform box one cubic foot at 5 h. 33 m. 20 s. Fallen against the side at 5 h. 34 m. 30 s. Fallen and taken out of box at 5 h. 35 m. 27 s. More chloroform at 5 h. 36 m. 14 s. Stopped chloroform at 5 h. 37 m. 5 s. Commenced incisions in the neck 5 h. 37 m. 43 s. More chloroform at 5 h. 39 m. 20 s. Stopped chloroform 5 h. 40 m. 5 s. Divide sterno cleido mastoid muscle at 5 h. 40 m. 27 s. Loop under left vagus at 5 h. 41 m. 37 s. More chloroform at 5 h. 42 m. 6 s. Stopped chloroform at 5 h. 42 m. 43 s. Open trachea at 5 h. 42 m. 47 s. Tube inserted into trachea at 5 h. 43 m. Opening chest wall while artificial respiration maintained by means of a Junker bellows. Chloroform from time to time a few whiffs at 5 h. 44 m. 15 s. Opening the pericardium at 5 h. 47 m. 50 s. Needle into heart at 5 h. 48 m. 30 s. Irritation left vagus, coil 5, at 5 h. 50 m. 35 s. Stopped irritation at 5 h. 50 m. 47 s. Irritation left vagus at 5 h. 51 m. 10 s. Stopped irritation at 5 h. 51 m. 27 s. Chloroform at 5 h. 52 m. 3 s. Irritation of left vagus at 5 h. 52 m. 37 s. Stopped irritation at 5 h. 53 m. 22 s. Diaphragm contracting rhythmically. Heart slow and feeble at 5 h. 53 m. 30 s. Heart almost stopped. Began artificial respiration again at 5 h. 54 m. 35 s. Heart more vigorous at 5 h. 55 m. 27 s. Irritation of left vagus not acting made him cough, coil 6, at 5 h. 56 m. Irritation left vagus, coil 6, at 5 h. 56 m. 35 s. Acting fully. Irritation of left vagus continued at 5 h. 56 m. 57 s. Chloroform at 5 h. 57 m. 15 s. Stopped irritation at 5 h. 57 m. 40 s. Irritation of left vagus again at 5 h. 58 m. 23 s. Coils run up to zero at 5 h. 59 m. 20 s. The heart stopped at first, but is now going again. Stopped irritation at 5 h. 59 m. 46 s. Irritation of left vagus again at 6 h. 0 m. 20 s. Run up to zero at 6 h. 0 m. 30 s. Stop up outlet for air at 6 h. 2 m. 23 s. Stop chloroform and artificial respiration at 6 h. 2 m. 55 s. Stop irritation at 6 h. 3 m. 10 s. Air let out of the chest at 6 h. 3 m. 35 s. Artificial respiration again at 6 h. 3 m. 55 s. Heart hardly beating at 6 h. 5 m. 15 s. Heart stopped at 6 h. 6 m. 30 s.

November 30.—No. 146.

Dog, weight 35 lbs., that has had three doses of phosphorus, one grain each day, on the 25th, 26th, and 27th instant respectively. [Of twelve dogs similarly dosed four have already died.] Into chloroform box at 10 h. 27 m. 50 s. Fallen down at 10 h. 32 m. 25 s. On the table at 10 h. 33 m. 15 s., and given chloroform from time to time. Left carotid ligatured and canula inserted into it. Connexion with manometers at 10 h. 56 m. 35 s. Two Ludwig and one Fick tracing during administration of ether persistently, with more or less perfect exclusion of air, until death resulted. (See p. 62.) Both sides of the heart distended with venous blood. Heart and liver both fatty.

Observation.

- H. M. S.
- A. 10 50 0.—Ether administered with very little air. This observation, especially the Fick readings, shows again that ether has precisely the same action as chloroform, but is less intense.

November 30th.—No. 147.

Another pariah to which phosphorus has been given as in the case of 146. Is, however, more sickly. Into chloroform box at 11 h. 32 m. 57 s. Fallen down at 11 h. 40 m. 41 s. Placed on the table and kept quiet with chloroform. Canula inserted into artery at 11 h. 51 m. 7 s. One Ludwig and one Fick tracing during the administration of chloroform persistently until death resulted (see page 62). At the commencement there was a sudden fall of pressure—the result of holding the breath.

Observation.

- H. M. S.
- A. 11 59 45.—Chloroform. The animal held its breath, the effect being well seen in Fick 3. The pressure fell rapidly and several deep gasps were taken. The respiration stopped at 12 h. 1 m. 25 s. The heart continued beating till 12 h. 8 m. 0 s.

November 30th.—No. 148.

A thin phosphorus dog of the same batch as 146 and 147. (Has had chloroform this morning, but was revived by artificial respiration.) Into chloroform box at 2 h. 30 m. 37 s. Fallen down at 2 h. 40 m., and taken out of box. Placed on the table and kept under with chloroform. Artificial respiration at 2 h. 42 m. 20 s. until 2 h. 42 m. 50 s. Artery ligatured and canula inserted. Connexions with manometers at

2 h. 49 m. 50 s. Three Ludwig and four Fick tracings showing the effect of (a) giving chloroform on a cap crammed on closely over the face so as to partially asphyxiate the animal, compared with the gradual fall of pressure that occurs when chloroform is properly administered with air; (b) giving ether in the same way; (c) giving ammonia in the same way; (d) holding the dog's mouth and nose so as to produce asphyxia without chloroform or ether, and (e) irritation of the right vagus. The dog was eventually killed by making him inhale concentrated chloroform vapour through a tube tied into the trachea.

Remarks.—Experiment 148, Ludwig I., II., III., and Fick I., II., III., IV., shows the difference between chloroform administration (a) when the respiration is embarrassed by struggling and holding the breath consequent on the attempt to make the animal inhale unduly strong vapour, and (b) when chloroform vapour is diluted and the respiration is natural and free. If Ludwig I. and Fick I. and II. are carefully examined, it will be found that every time chloroform is given with insufficient air so as to cause the animal to hold its breath and struggle from asphyxia, irregularity of the blood-pressure was produced, which recurred when the animal was recovering. This corresponds exactly with the irregularity in the Glasgow traces A, B, &c., on the one hand, and on the other in the irregularity caused by artificial stimulation of the vagus. With reference to this point, compare traces 137, Ludwig I., between 12.25 and 12.26, with trace 148, Ludwig I., between 3.1 and 3.3. It was in Experiment 148 that the Commission first became fully aware of the vital importance of natural respiration in chloroform administration. The tracings show that even the slightest struggling (vide Ludwig II., 3.36 to 3.39), or interference with respiration (vide Ludwig III., 4.2 to 4.5) caused a corresponding irregularity in the blood-pressure. But whenever the chloroform was given so that the respiration was natural the blood pressure was perfectly regular, as is seen in Ludwig I. at 3.17 and Fick III., reading 12. The tracings of Experiment 148 also show the effects of simple asphyxia and of electrical irritation of the vagus for 20 seconds (vide Fick IV., reading 23). (See page 65).

Observations.

- H. M. S.
- A. 2 50 0.—Chloroform on a cap held close over the face; the animal struggled and held its breath. There was a rapid and irregular fall of pressure (vide Fick 2).
- B. 2 53 30.—Chloroform in the same way; same effects produced (vide Fick 3).
- C. 3 1 30.—Chloroform in the same way; same effects produced, but to such a marked degree that it was thought a clot had collected in the tubes see Fick 4, Interruption.
- D. 3 12 0.—Chloroform as before; same effects produced (note Fick 6).
- F. 3 17 0.—Chloroform with sufficient air to ensure regular breathing; there was no struggling or holding of the breath, and no irregularity of the blood-pressure or circulation. Fick 7 is worthy of notice, though it records the pulse as the animal was almost coming round.
- G. 3 21 10.—Chloroform with insufficient air; same effects as at A, B, and C; shown very markedly in Fick 8.
- H. 3 35 0.—Inhalation of ammonia.
- I. 3 36 45.—Chloroform again with plenty of air. There was slight struggling at first and slight corresponding irregularity in the fall of blood-pressure. Fick 12, taken when the pressure was getting very low, shows beautifully the regularity of the pressure and pulse tracing when the breathing is regular, and ought to be contrasted and compared with Fick 2, 3, 4, 6, 8, and 11.
- J. 3 45 50.—Ether on cap held close over the face; struggling and holding the breath. Fick 14 and 15 show effects on the pressure and pulse, similar to those produced when chloroform is given in the same way. Compare Fick 14, 15, and 16 with Fick 7, 8, and 9.
- K. 3 54 20.—Simple asphyxia showing rapid fall of pressure and irregular pulse (vide Fick 17).
- L. 4 1 25.—Chloroform again with plenty of air. Breathing slightly irregular from groaning; there is a corresponding slight irregularity in the tracing.
- M. 4 15 15.—Electrical irritation of right vagus: coil 10.
- N. 4 16 40.—Chloroform again with sufficient air to ensure regular breathing. This observation was interrupted by clotting in the tubes.
- O. 4 20 0.—Electrical irritation of right vagus: coil 10.
- P. 4 31 0.—(An open tube had been placed in trachea in the interval.) Chloroform on cap over the mouth of the tube. Effect kept up by artificial respiration till death: heart stopped at 4 h. 41 m. 0 s.
- Q. 4 42 0.—Artery cut; pressure fell to zero.

If the Fick tracings of Experiment No. 148 be compared with the photographic reproduction of tracings A and C of the Glasgow Committee, it will be seen that they are identical, and that the slow action of the heart, with great fall of pressure, which the Glasgow Committee attributed to some capricious action of chloroform upon the heart, was undoubtedly due to stimulation of the vagus from asphyxia. The tracings of the Glasgow Committee's experiments show nothing more than that chloroform lowers the blood-pressure, and that sometimes under chloroform the fall of pressure is sudden and irregular. When once it is proved, as it is by the experiments of the Hyderabad Commission, that there is no danger in either sudden or gradual falls of the blood-pressure, unless the heart is weakened by interference with its nutrition, the whole of the Glasgow Committee's contention, with regard to the danger of chloroform to the heart and the necessity for feeling the pulse during its administration, falls to the ground.

December 2nd.—No. 149.

Monkey of fair size. Temperature of the room 19 Cent. Into chloroform box at 8 h. 20 m. 50 s. Fallen down at 8 h. 24 m. 40 s. Placed on the table at 8 h. 25 m. 40 s. and kept quiet with chloroform. Left carotid ligatured and canula inserted into it. Right carotid looped. Trachea opened, and a glass tube connected with the india-rubber pump of the Junker apparatus and provided with an exit tube tied into it for artificial respiration. Connexion with the manometers shortly before 8 h. 54 m.

One Ludwig and one Fick tracing.

Observations

- H. M. S.
 A. 8 55 30.—Ligature of the right carotid.
 B. 8 55 40.—Struggling.
 C. 8 57 30.—Chloroform administration on a sponge held in front of the tracheal tube.
 D. 9 0 40.—Chloroform administration by letting the animal breathe through the Junker bottle without the india-rubber bellows attachment, and pushing chloroform in this way until respiration stopped.
 E. 9 4 0.—Artificial respiration in the ordinary way by compressing the chest.
 F. 9 9 0.—After recovery, artificial respiration continuously by means of the India-rubber bellows of the Junker apparatus attached to the tracheal tube, while measures were being taken to separate the head from the body.
 G. 9 10 20.—Slight hæmorrhage from a large artery.
 H. 9 18 0.—Slight hæmorrhage from the jugular vein.
 I. 9 22 30.—Pumping chloroform vapour through the Junker apparatus into the trachea until respiration ceased.

After the tracing ended, the head was severed, and the animal gave a few diaphragmatic gasps, but eventually died, the heart stopping finally at 9 h. 35 m.

December 2nd.—No. 150.

Full-sized pariah. Weight 30½ lbs. Into chloroform box at 11 h. 10 m. 55 s. Fallen down at 11 h. 21 m. 50 s. Placed on the table at 11 h. 23 m. 45 s., and kept quiet with chloroform. Loop under both vagi and canula inserted into left carotid in the usual way. Connexion made with the manometer at 11 h. 41 m. 15 s. Three Ludwig and two Fick tracings (the 1st Fick reading is incorporated with the Fick of 149).

Observations.

- H. M. S.
 A. 11 42 50.—Smothering by holding the mouth and nose tightly closed. The effect of this is shown in Fick 2. The pulse fell from 116 before the smothering to 38 after.
 B. 11 45 0.—Gradual chloroform administration with plenty of air in the ordinary way.
 C. 11 48 30.—Smothering again while the animal was well under chloroform.
 D. 11 50 20.—Smothering again when it was just about to come out of chloroform.
 E. 11 53 45.—Giving chloroform again for a short time and then at 11 h. 55 m. 15 s. smothering the animal, during which proceeding respiratory movements completely ceased, and though a spontaneous attempt was made to breathe artificial respiration became necessary.
 F. 12 4 5.—Giving chloroform again with lots of air, and as soon as the animal's cornea was insensitve, smothering it.
 G. 12 9 30.—Giving chloroform with the cap crammed on to the muzzle so as to admit very little air, and pushing it until respiration ceased. Artificial respiration at 12 h. 11 m. 30 s.
 H. 12 17 35.—Smothering again (*vide* Fick 7 and 8). These observations were accompanied by *very violent struggling*, and the smothering was consequently ineffectual.
 I. 12 23 15.—Smothering again. The pressure fell 20 mm. The effect of simple smothering in lowering the blood-pressure and slowing the pulse is well shown in the Ludwig tracing and in Fick 10; compare with Fick 2.
 J. 12 37 30.—Division of both vagi.
 K. 12 38 20.—Giving a little chloroform at times to keep the animal under.
 L. 12 40 20.—Smothering again. Fick 13 and 14 show that smothering after division of the vagi did not cause any slowing of the pulse as it did when the vagi were intact.
 M. 12 48 0.—Inhalation of amyl nitrite, of which, however, the quality was very doubtful.
 N. 12 51 30.—Chloroform was then pushed until respiration ceased, and the animal died in spite of artificial respiration.

Before the last observation the animal's temperature had fallen below 95 F.

December 2nd.—No. 151.

Temperature of the room 23 Cent. Fair-sized pariah, very thin, and wounded. Weight 23½ lbs. Into chloroform box at 3 h. 14 m. 3 s. Fallen down at 3 h. 20 m. 5 s. Placed on the table at 3 h. 20 m. 30 s. Loop under both vagi. Temperature in the rectum at 3 h. 26 m. 101 F. Artery ligatured at 3 h. 26 m. 47 s. Canula inserted at 3 h. 27 m. 55 s. Connexion with manometer at 3 h. 44 m. 30 s. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 3 46 20.—Ordinary chloroform administration at various times.
 B. 3 50 30.—Smothering by holding the mouth and nose. The blood-pressure fell 25 mm. and the pulse dropped from 72 to 31 per minute.
 C. 3 55 0.—Cutting both vagi.

H. M. S.

- D. 3 58 25.—Smothering again. The effect of smothering, now that the vagi are cut, is to cause an inappreciable fall of blood-pressure, and acceleration of the pulse to 105 per minute; compare Fick 2 and 10 of Experiment 150, and Fick 3 of 151, with Fick 5 and 6 of 151. The difference in the effects of smothering before and after division of the vagi is obviously due to the section of the nerves.
 E. 4 1 40.—Artificial respiration.
 F. 4 3 30.—Pushing chloroform until respiration ceased.
 G. 4 8 10.—Inhalation of amyl nitrite of somewhat better quality than in the last experiment.
 H. 4 16 50.—Chloroform again with struggling and eventual death in spite of artificial respiration. Temperature in the rectum at death 96 F.

December 3rd.—No. 152.

Rabbit, weight 3½ lbs. Temperature of the room 19 Cent. Chloroform at 7 h. 52 m. in a cubic foot box. Fallen down at 7 h. 59 m. 15 s. Taken out of box at 7 h. 59 m. 45 s. and kept quiet with chloroform. Canula inserted into left carotid. Connexion with manometer a little before 8 h. 35 m. One Ludwig tracing and two Fick readings on the same tracing as 154. Chloroform was first given gradually and then pushed by pressing the cap closely upon the animal's nose and mouth. The effect of this latter proceeding is not shown in the tracing, owing to the artery becoming hopelessly drawn out of its sheath and twisted. Respiration ceased at about 8 h. 52 m. 30 s. and the heart was still beating when the observation ceased at 9 h.

December 3rd.—No. 153.

Rabbit, weight 3½ lbs. Temperature of the room 19·7 Cent. Into chloroform box at 9 h. 45 m. 40 s. Fallen down at 9 h. 52 m. 40 s. Taken out at once, but not being properly under, was put in again. The box was afterwards opened from time to time, but the animal was never fully insensitve. Convulsions began at 10 h. 9 m. 55 s., and it was then taken out of box, and as it was not under, it was given more chloroform on a cap at once. It stopped breathing and artificial respiration was begun at 10 h. 11 m. 40 s. Heart was still beating very rapidly, but efficiently when the thorax was opened at 10 h. 14 m. 45 s. Auricle only beating at 10 h. 52 m. 30 s. Auricle still beating regularly, though slowly, at 11 h. 49 m. Auricle still beating, but more feebly, at 12 h. 7 m. A portion of the auricle was still beating slowly at 1 h. 2 m., although all the organs had begun to shrivel up by drying.

December 3rd.—No. 154.

Temperature of room 20½ Cent. Monkey, fair-sized, but thin and wounded, weight 9½ lbs. Into chloroform box at 10 h. 44 m. Fallen against the side at 10 h. 51 m. 15 s., but still winking. Came out completely at 10 h. 53 m. 30 s., and more chloroform was put into the box. Taken out of box at 10 h. 55 m. 50 s. and placed on the table and kept quiet with chloroform, while an operation to expose the spinal cord was performed. Temperature 102·8 F. in the rectum at 11 h. 3 m. Spinal cord exposed opposite the 5th cervical vertebra at 11 h. 8 m. Left carotid ligatured at 11 h. 14 m. 20 s. Canula inserted at 11 h. 15 m. 43 s. One Ludwig tracing and a part of one Fick (incorporated with 152).

Observations.

- H. M. S.
 A. 11 20 45.—Ordinary chloroform administration.
 B. 11 26 0.—Chloroform by Junker's inhaler attached to the tracheal tube.
 C. 11 27 15.—Artificial respiration by the Junker bellows attached to the tracheal tube.
 D. 11 30 30.—Severance of the spinal cord at about the fifth cervical vertebra.
 E. 11 33 0.—Chloroform again by Junker continued until the heart almost ceased beating.

December 3rd.—No. 155.

Fair-sized monkey, weight 9½ lbs. Temperature of the room 23 Cent. Into chloroform box at 2 h. 31 m. 28 s. Fallen down at 2 h. 40 m. Placed on the table and kept quiet with chloroform while the spinal cord was being exposed, during which proceeding there was a loss of about 1 oz. of blood. Temperature in the rectum 102 F. at 2 h. 45 m. Artery ligatured 2 h. 51 m. 45 s. Canula inserted at 2 h. 55 m. 30 s. Trachea opened and tube inserted at 2 h. 57 m. 50 s. Connexion made with manometer at 3 h. 2 m. A little chloroform was accidentally thrown into the trachea by the Junker apparatus and death resulted in spite of artificial respiration.

December 3rd.—No. 156.

Weight 27½ lbs. A large pariah that has had two grains of phosphorus this morning. Into chloroform box at 3 h. 26 m. 30 s. Fallen down at 3 h. 39 m. 35 s. and placed on the board at 3 h. 40 m. 10 s. Artery ligatured at 3 h. 46 m. 50 s., and canula inserted at 3 h. 48 m. Loop under both vagi. Connexion made with manometer at 3 h. 51 m. 7 s. One Ludwig and two Fick tracings. (See p. 65.)

Observations.

- H. M. S.
 A. 3 56 40.—Administration of chloroform with a cap closely applied to the muzzle (Fick 2 shows the extreme inhibition of the heart's action probably owing to vagus stimulation from interference with the respiration).
 B. 4 0 5.—Gradual administration of chloroform with plenty of air.
 C. 4 3 55.—Simple smothering without chloroform by holding the mouth and nose (compare Fick reading 5 with Fick reading 2). These readings are identical (1) with each other; (2) with Fick reading 4 and 9 of Experiment 117, which are tracings of simple vagus irritation; (3) with Fick Reading 11 of Experiment 64, which is a tracing of vagus irritation and chloroform administration combined; (4) with Fick Reading 13 of Experiment 178, which records the arrest of the heart, after stoppage of the respiration by chloroform poisoning; and (5) with the Glasgow tracings A and C, more especially C.

- H. M. S.
 D. 4 7 0.—Division of both vagi.
 E. 4 10 35.—Simple smothering again (compare the extremely rapid pulse in Fick 7 with the slow pulse of Fick 5 before the vagi were divided).
 F. 4 14 50.—Chloroform again with the cap closely applied while the pulse was still extremely rapid (compare No. 151). The pressure fell rapidly, and after the chloroform was stopped the animal gave two or three convulsive gasps in rapid succession which had no effect on the pressure.
 G. 4 16 20.—Artificial respiration failed to restore the animal, and the heart stopped beating about six minutes after the last gasp. Temperature 101.4 F. Thorax opened at 4 h. 23 m. Heart quite still, but irritable.

December 4th.—No. 157.

A large pariah, weight 38 lbs., that had three grains of phosphorus yesterday—one in the morning and two in the evening. Temperature of the room 18½ Cent. Into chloroform box at 7 h. 58 m. 30 s. Fallen down at 8 h. 4 m. 59 s. Left carotid ligatured and canula inserted. Temperature 100.6 F. in the rectum. Both vagi looped. Connexion with manometer at 8 b. 26 m. 40 s. Two Ludwig and two Fick tracings.

Observations.

- H. M. S.
 A. 8 27 0.—Ordinary chloroform administration.
 B. 8 28 15.—A remarkable fall of pressure and slowing of the pulse (*vide* Fick 2) that occurred after the chloroform had been stopped. The apparatus for holding the dog's muzzle was being removed at the time, but no exact cause could be assigned for the fall of pressure (which resembles that produced by asphyxia in other phosphorus dogs), except that the animal was holding its breath. After about a minute the pressure and pulse were restored to their previous condition without artificial respiration or other interference.
 C. 8 35 0.—Snipping of the margin of the anus (Fick 3).
 D. 8 38 40.—Chloroform with the cap closely applied to the muzzle (*vide* Fick 4).
 E. 8 42 45.—Chloroform again (the animal struggling and holding breath); pushed until respiration had stopped.
 F. 8 44 0.—Artificial respiration.
 G. 8 45 0.—Division of both vagi.
 H. 8 48 20.—Chloroform very gently with lots of air until respiration had almost stopped.
 I. 8 57 20.—Chloroform again pushed until the respiration ceased entirely.
 J. 8 59 0.—Artificial respiration for broken periods. At one time the artificial respiration appeared to have the effect of preventing the natural rise of pressure (*vide* the Ludwig tracing just after Fick reading 9). The animal now entered into a completely anomalous condition in which he gasped slowly and irregularly, and the pressure rose and fell in the most rapid manner without any apparent reason.
 K. 9 10 40.—Irritation of the peripheral end of the right vagus, at first with the coils distant 15, and afterward 10 centimetres, the latter proving effective.
 L. 9 13 50.—Pushing chloroform until death resulted (the tracing was interrupted by clots in the tubes which were only cleared just before death.)

December 4th.—No. 158.

Large pariah, weight 37 lbs., that had three grains of phosphorus yesterday like 157. Into chloroform box at 10 h. 23 m. 20 s. Fallen down and at once placed on the table at 10 h. 23 m. 45 s. Kept quiet with chloroform from time to time. Temperature 101 F. Breathing very feeble and slow at 10 h. 31 m. 30 s. and artificial respiration performed now and again until 10 h. 46 m. Artery ligatured at 10 h. 38 m. and canula inserted. Connexion with the manometers at 10 h. 47 m. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
 A. 10 51 55.—Ordinary chloroform administration, struggling and holding the breath.
 B. 11 4 0.—Pushing chloroform until respiration stopped.
 C. 11 8 10.—Injection of liquor atropinæ 10 minims into the peritoneum.
 D. 11 12 5.—Irritation of the right vagus to test the effect of atropine.
 E. 11 13 30.—Injection of 20 minims more liquor atropinæ into peritoneum.
 F. 11 16 30.—Irritation of the right vagus again, with now a distinct rise of pressure. The vagi are paralysed by the atropine.
 G. 11 21 0.—Pushing chloroform gently, but not without some struggling and holding the breath.
 H. 11 29 0.—Smothering by holding nose and mouth (*vide* Fick 4, in which the pulse is alternately slow and quick according to the phase of respiration, but distinct vagus irritation is absent, and compare with Fick 2 and 5 of 156).
 I. 11 31 0.—Pushing chloroform until respiration ceased; artificial respiration failed to restore the animal.

December 4th.—No. 159.

Temperature of the room 23.5 Cent. Dog, weight 35 lbs., that has had phosphorus (one grain yesterday, one to-day). Into chloroform box at 3 h. 3 m. 45 s. Fallen down at 3 b. 8 m. 8 s. and placed on the table at once and given chloroform from time to time to keep it quiet. Breathing stopped and artificial respiration performed at 3 h. 14 m. 35 s. and continued for a few seconds. Temperature in rectum 101.9 F. Canula inserted into the artery at 3 h. 17 m. 10 s. Connexion with manometer at 3 h. 19 m. 8 s. The animal was fully sensitive and chloroform was given almost immediately. Violent struggling with

the breath held ensued and afterwards deep inspirations and howling, during which he must have inhaled chloroform very freely. Chloroform was stopped after one minute and respiration ceased after about three-quarters of a minute more. Artificial respiration was at once commenced, and after about 3½ minutes there were a few feeble gasping respiratory movements, which did not, however, raise the mean blood-pressure at all. Artificial respiration was continued for five minutes longer, but failed to restore the animal, the heart ceasing to beat about ten minutes after the chloroform was commenced. The liver was distinctly fatty, and the heart appeared to be soft and flabby. One Ludwig tracing only.

December 4th.—No. 160.

Pariah dog, weight 24 lbs., has had two grains of phosphorus at 159. Into chloroform box at 3 b. 38 m. 24 s. Fallen down at 3 h. 49 m. 20 s. Placed on the table at once. Canula inserted into the left carotid at 3 h. 55 m. 45 s. Connexion with manometer at 3 h. 59 m. 30 s. One Ludwig tracing only. Chloroform was given at first very gently with plenty of air until the animal was fully under. The animal's head was then placed in a bladder which communicated with an apparatus (described in Appendix) for generating carbonic acid and the inhalation of this gas commenced. Blood-pressure fell slowly at first, but afterwards more rapidly. After 3½ minutes the respiration stopped, and the bladder was at once taken off the dog's head and air freely admitted while artificial respiration was commenced. Gasping respiratory movements occurred after about a minute, but had little or no effect upon the blood-pressure, and ceased finally after another minute. Artificial respiration was resumed, but without avail. The liver was not apparently fatty.

December 6th.—No. 161.

Temperature of the room 20 Cent. Large pariah, weight 26 lbs., that has had three grains of phosphorus in one-grain daily doses, but is not particularly sick, though out of a batch of seven, of which he is one, who were dosed with phosphorus in the same way, three died in the course of the day. Into chloroform box at 10 h. 11 m. 20 s. More chloroform into the box at 10 h. 17 m. 40 s. Fallen down at 10 h. 22 m. 40 s. Placed on the table at 10 b. 23 m. 25 s. Slight convulsions at 10 h. 25 m., after which the breath was held for about half a minute and artificial respiration was employed for a few seconds. More chloroform at 10 h. 25 m. 55 s. as the animal was sensitive and groaning. Temperature in the rectum 100.4 F. Chloroform stopped again at 10 h. 27 m. 50 s. More chloroform at 10 h. 29 m. 25 s. Artery ligatured at 10 h. 30 m. Stop chloroform again at 10 h. 30 m. 10 s. Canula inserted at 10 b. 31 m. 52 s. More chloroform at 10 h. 33 m. 50 s. until 10 h. 34 m. 30 s. More chloroform again at 10 h. 34 m. 40 s. Stop chloroform at 10 h. 35 m. 20 s. Connexion made with manometer at 10 h. 36 m. 30 s. Three Ludwig and two Fick tracings. (See p. 66.)

Observations.

- H. M. S.
 A. 10 39 25.—Administration of alcohol by Junker's inhaler, the tube introduced into the nostril (the pressure in this animal fell in a marked way whenever he struggled).
 B. 10 45 0.—Alcohol continued, but close-fitting inhaler used in place of the tube in the nostril.
 C. 10 51 30.—Chloroform administration with struggling.
 D. 10 59 10.—Inhalation of carbonic acid and chloroform at the same time (*vide* especially Fick reading 3).
 E. 11 9 4.—Carbonic acid inhalation again (after giving fresh air), and for a short time chloroform as well (*vide* Fick 6).
 F. 11 24 0.—Carbonic acid inhalation again with more careful exclusion of air. After the carbonic acid was stopped he breathed spontaneously for a short time, but artificial respiration then became necessary at intervals.
 G. 11 48 0.—Lastly, smothering by handgiving mouth and nose with an elastic band until he died.

December 6th.—No. 162.

Weight 9 lbs. Monkey that had half a grain of morphine at 12 o'clock hypodermically. Into chloroform box at 2 h. 25 m. 5 s. Fallen down at 2 b. 32 m. 15 s. and at once placed on the board. Artery ligatured and canula inserted as usual. Connexion with manometer at 2 h. 50 m. 15 s. Two Ludwig and one Fick tracing during repeated administrations of chloroform until respiration ceased, with an increasing interval on each occasion before commencing artificial respiration until at last it failed to restore life.

Observations.

- H. M. S.
 A. 2 52 55.—Gentle chloroform administration with plenty of air. At first there were irregularities in the respiration, sneezing for example, and the trace is slightly irregular. The respiration then became regular, and the fall of pressure was perfectly regular until cessation of the respiration at 2 h. 58 m. 0 s. Artificial respiration was commenced at 2 h. 58 m. 30 s. and stopped at 2 h. 59 m. 20 s. The animal then went into a profound sleep until 3 b. 10 m. 35 s., when more chloroform was given.
 B. 3 14 30.—More chloroform. The respiration stopped at 3 h. 16 m. 0 s. Artificial respiration was commenced at 3 h. 16 m. 40 s. and the animal was fully restored at 3 h. 23 m. 0 s. The artificial respiration was stopped from 3 h. 18 m. 35 s. to 3 h. 19 m. 0 s., when Fick 6 was taken. There is barely any pulse tracing to be seen in Fick reading 6, but the heart was not weakened and the animal was revived completely by continued artificial respiration.
 C. 3 27 5.—Chloroform more freely than before. Respiration stopped at 3 h. 28 m. 0 s. and artificial respiration was commenced at 3 h. 29 m. 15 s. Fick 9 was taken at 3 h. 28 m. 55 s. and shows entire absence of pulse tracing, and yet, as in Fick 6, the heart was not weakened, and the animal was again rapidly restored by artificial respiration.

H. M. S.

- D. 3 38 40.—Repetition of B and C. This time the animal at first struggled and held its breath, and there was consequent irregularity of the circulation (*vide* the Ludwig tracing and Fick 11). The respiration stopped at 3 h. 39 m. 40 s., and Fick 12 shows complete absence of pulse tracing again. Artificial respiration was commenced at 3 h. 41 m. 30 s. and the animal was easily restored.
- E. 3 48 10.—Chloroform pushed till death; the respiration stopped at 3 h. 52 m. 0 s., and the heart stopped at 3 h. 57 m. 30 s.

Experiment 162 shows that absence of the pulse tracing, which was observed every time the respiratory centre was paralysed, is no proof whatever that the heart has ceased to act, or though it has ceased to act temporarily, that it has failed. It is remarkable that when the heart stopped (*vide* Fick 6, 9, and 12 and the Ludwig tracing on either side of these readings) there was no further fall of blood-pressure, showing that at the time of cessation the pressure was already as low as it could be. If direct weakening of the heart were the cause of the fall of blood-pressure in chloroform administration, we ought to find the heart-beats getting smaller and smaller up to the time when the pressure reaches its lowest, and gradually growing bigger and bigger again on the other side as the effect of the chloroform wears off. Instead of this Experiment 162 shows that there were ample pulsations on both sides of the temporary pauses. If Fick 9, with the Ludwig tracing on either side, is carefully studied, it will be seen that up to the time the heart beats ceased, the pulsations recorded in the Ludwig were ample and strong. There was then a temporary arrest of pulsation for 6 seconds (*vide* Fick 9). Immediately after Fick 9 the pulsation returned for 5 seconds (*vide* the Ludwig between 3 h. 28 m. 0 s. and 3 h. 29 m. 0 s.). Afterwards there was a long pause of 20 seconds without any pulsations at all. This pause was so marked that Dr. Bonford thought a clot had formed in the tube, and at 3 h. 29 m. 10 s. he wrote on the Ludwig tracing "clot." Artificial respiration was just about to be commenced when the animal gave two spontaneous gasps, vigorous pulsations followed and the pressure was raised in five seconds to the height it was at before chloroform was administered in Observation C.

December 7th.—No. 163.

Temperature of the room 23 Cent. Medium-sized pariah, weight 25½ lbs. that has had three grains of phosphorus, one daily on the 3rd, 4th, and 5th instant. Is now very feeble and can hardly stand. Tied on to the dog-board at 10 h. 44 m. 15 s. Given chloroform on the ordinary cap at 10 h. 44 m. 45 s. Operation to tie carotid commenced at 10 h. 45 m. 30 s. Chloroform stopped at 10 h. 46 m. 45 s. Canula inserted into carotid at 10 h. 50 m. 15 s. Temperature in rectum 94.6 F. Connexion made with manometer at 10 h. 55 m. One Ludwig and one Fick tracing during very gradual administration of chloroform, the animal's head being inserted through an opening in the side of a large box (8 feet cubic contents) and carefully packed with wet cloths after one ounce of chloroform had been introduced into the box on blotting paper. Post-mortem—Temperature 94.8 F.

December 7th.—No. 164.

Temperature of the room 23 Cent. Another phosphorus dog of the same hatch, but does not appear to be particularly ill. Weight 29 lbs. Tied down on the board and given chloroform on a cap at 11 h. 27 m. 40 s. Chloroform stopped at 11 h. 29 m. 6 s. More chloroform at 11 h. 30 m. 45 s. Stopped again at 11 h. 31 m. 6 s. Both pupils dilated. Artery ligatured at 11 h. 31 m. 45 s. Temperature in the vagina 102 F. Canula inserted at 11 h. 34 m. 6 s. More chloroform at 11 h. 36 m. 10 s. Connexion made with manometer at 11 h. 39 m. 10 s. Two Ludwig and one Fick tracing.

Observations.

- H. M. S.
- A. 11 39 0.—Rapid chloroform administration while struggling and holding breath. Great irregularity is observed in the Ludwig tracing.
- B. 11 41 0.—Gentle administration of chloroform in the ordinary way so as not to excite struggles. The contrast to Observation A is very marked.
- C. 11 44 0.—Very gradual administration with the large box as in 163.
- D. 11 52 40.—Snipping the skin of the thigh.
- E. 11 53 50.—Excision of one of the nipples.
- F. 11 55 10.—Evulsion of nails.

After these at 12 h. 2 m. 0 s. the box was opened and the air freshened by means of a bellows and then closed again after another ounce of chloroform had been introduced. This was continued until the animal died. The respiration ceased at 12 h. 12 m. 0 s., and the heart stopped at 12 h. 18 m. 30 s. Post-mortem—Temperature 101 F. Liver very friable, but very congested and of a dark colour. Heart distended.

December 7th.—No. 165.

Monkey, weight 9 lbs., to whom one drachm of tincture of cantharides was given by the stomach yesterday evening and another this morning, and it does not appear to be ill at all. Placed on the board and given chloroform at 2 h. 41 m. 40 s. Chloroform stopped at 2 h. 45 m. 30 s. Chloroform again at 2 h. 47 m. 5 s. for a short time. Again at 2 h. 49 m. Artery ligatured at 2 h. 52 m. 5 s. and more chloroform at 2 h. 52 m. 30 s. Stopped again at 2 h. 53 m. 10 s. No urine in the bladder. Loop under the internal jugular vein. Canula inserted at 2 h. 56 m. A little chloroform again at 2 h. 57 m. 5 s. One Ludwig tracing and one Fick reading on the same tracing as 167. Chloroform was given very freely on a cap closely applied while the animal was struggling. He then alternately held his breath and gave deep gasps while the pressure fell rapidly. Respiration stopped. Chloroform was discontinued and artificial respiration was performed. He afterwards breathed in a feeble snorting way for a short time and then stopped finally. Artificial respiration was again performed for several minutes, but without effect, the heart gradually ceasing. The bladder was empty and the kidneys congested. The mesentery was very much congested.

December 7th.—No. 166.

Unusually large pariah dog, weight 3½ lbs. (unpoisoned, but old and toothless). Placed on the table struggling violently and given chloroform at 3 h. 27 m. 10 s. Chloroform stopped at 3 h. 28 m. 50 s. Struggling again and given more chloroform from 3 h. 31 m. 30 s. to 3 h. 33 m. 10 s.

Artery ligatured at 3 h. 33 m. Noticed to have stopped breathing at 3 h. 34 m. 5 s. and artificial respiration was performed until 3 h. 39 m. A needle thrust into his heart at that time did not beat. Lungs pigmented and bloodless. Mitral valve almost cartilaginous on its free margin. The dog's death was the result of inattention on the part of the attendants, who were seeing how quickly they could tie the artery and were not watching the respiration.

December 7th.—No. 167.

Pariah, weight 38½ lbs. (unpoisoned and healthy). Into chloroform box at 3 h. 50 m. 50 s. Fallen down at 3 h. 54 m. 30 s. and placed on the board at once. More chloroform at 3 h. 55 m. 45 s. Stopped at 3 h. 57 m. More chloroform at 3 h. 58 m. Artery ligatured at 4 h. 50 s. Chloroform stopped at 4 h. 1 m. 15 s. Artery ligatured and canula inserted. More chloroform at 4 h. 3 m. 35 s. Stopped at 4 h. 5 m. 3 s. Connexion made with the manometer at 4 h. 5 m. 20 s. One Ludwig and one Fick tracing (which includes the solitary reading of 165). After a little chloroform had been given 5 mm. of nicotine were injected into the peritoneum. Shortly afterwards the pressure began to fluctuate violently and the dog to gape as if he were about to vomit. Fick reading 2 was then taken and immediately afterwards the pressure rose steadily and with slight oscillations to above 250 mm. and landed the marker on the top of the drum. There was no apparent cause for this rise and no spasm was noticed; but in the confusion it may have been overlooked. The pressure soon fell again to about 180 mm. Chloroform was discontinued and respiration ceased for rather more than a minute. After another two minutes the pressure began to fall rapidly, and the administration of chloroform, which was continued for about half a minute, seemed to hasten this fall. The breathing soon after ceased and the animal died. Convulsive twitchings of the jaw, ears, and forepaws continued until after 4 h. 30 m. The movements continued for more than ten minutes after death, and were sufficiently forcible to jerk the handles of a pair of pressure forceps fixed on the end of the tongue off the table at each spasm.

December 9th.—No. 168.

Monkey, weight 9½ lbs., placed in the chloroform box at 10 h. 19 m. 44 s. Fallen down at 10 h. 28 m. 42 s. and at once placed on the table and kept quiet with chloroform. Artery ligatured at 10 h. 36 m. 47 s. Canula inserted at 10 h. 38 m. 55 s. Connexion with the manometer at 10 h. 42 m. 45 s.

One Ludwig tracing and part of one Fick (incorporated with 169 and 170).

Observations.

- H. M. S.
- A. 10 44 5.—Ordinary chloroform administration. No struggling; tracing regular.
- B. 10 46 0.—Chloroform administration. Struggling and holding the breath; very irregular breathing combined with corresponding irregularity of the circulation until 10 h. 53 m. 30 s.
- C. 10 50 0.—Continued gentle administration of chloroform with plenty of air until death. The respiration stopped at 10 h. 59 m. 30 s. and the heart at 11 h. 3 m. 0 s. Post-mortem—Temperature 100.8 F.

December 9th.—No. 169.

Dog 37½ lbs. Given chloroform at 11 h. 12 m. 30 s. Fallen down at 11 h. 15 m. 55 s. Placed on the table at 11 h. 16 m. 10 s. More chloroform given 11 h. 17 m. 47 s. Stopped at 11 h. 18 m. 25 s. More chloroform at 11 h. 19 m. 5 s. Artery ligatured at 11 h. 19 m. 55 s. Stopped chloroform at 11 h. 21 m. 5 s. Canula inserted at 11 h. 21 m. 21 s. More chloroform at 11 h. 22 m. 35 s. Stopped chloroform at 11 h. 23 m. 10 s. Connexion with manometer at 11 h. 24 m. 25 s. One Ludwig and part of a Fick tracing during continued gentle administration of chloroform until death.

- H. M. S.
- A. 11 27 5.—Chloroform gently.
- 11 30 55.—Respiration stopped.
- 11 34 45.—Heart stopped.

Remarks.—No. 169 is a good example of the most important point brought out by the experiments of the Commission. Whenever chloroform is properly administered the blood-pressure invariably falls gradually and regularly, as is shown in the Ludwig and Fick tracings of Experiment 169 (see p. 68); and the fall of pressure is in no sense dangerous if the inhalation is stopped when the subject is fully under the influence of the anæsthetic.

December 9th.—No. 170.

Weight 10½ lbs. Monkey that has had a drachm of tincture of cantharides yesterday and the day before. Into chloroform box at 11 h. 47 m. 43 s. Taken out and placed on the table at 12 h. 5 m. and kept quiet with chloroform from time to time. Artery ligatured at 12 h. 9 m. 20 s. Canula inserted at 12 h. 10 m. 36 s. Connexion with the manometer at 12 h. 13 m. 10 s. One Ludwig and a part of a Fick during gentle administration of chloroform until death ensued. Post-mortem—Temperature 104 F. Bladder quite empty. No visible congestion of the kidneys.

- H. M. S.
- A. 12 13 30.—Chloroform gently.
- 12 19 40.—Respiration stopped.
- 12 25 0.—Heart stopped.

December 9th.—No. 171.

Rabbit. Weight 3 lbs. Placed on the rabbit-board at 2 h. 43 m. 50 s. Given chloroform at 2 h. 45 m. and from time to time to keep it quiet. Artery ligatured at 2 h. 54 m. (very small). Canula inserted at 3 h. Connexion with the manometer at 3 h. 5 m. Part of one Ludwig tracing and of one Fick (incorporated with the tracings of 172).

Observations.

- H. M. S.
- A. 8 3 0.—Violent struggling.
- B. 3 8 40.—Chloroform administration pushed until the respiration ceased.

H. M. S.

- C. 3 10 10.—Artificial respiration; the artery was then accidentally torn and the tracing concluded, as it did not seem as if the animal was coming round. The heart continued to beat until 3 h. 17 m.

December 9th.—No. 172.

Another rabbit. Weight 3½ lbs. Tied on the rabbit-board and given chloroform at 3 h. 21 m. 23 s. Artery ligatured at 3 h. 25 m. 50 s. Canula inserted at 3 h. 29 m. 10 s. Connexion with the manometer at 3 h. 37 m. One Ludwig tracing, and one Fick (incorporated with 171).

Observations.

- H. M. S.
A. 3 38 15.—Gentle chloroform administration on a sponge before the nose; struggling.
B. 3 43 15.—Chloroform again while struggling and holding the breath. (The pressure rose every time the animal held its breath.) Violent struggling.
C. 3 45 30.—Chloroform on a cap closely applied to the face, with more struggling and holding of the breath.
D. 3 48 10.—Chloroform on a cap very gently without exciting struggles, and pushed until respiration stopped, and the heart was very feeble. A kink in the tube stopped the tracing. The heart continued to beat until 4 h. 9 m.

It is excessively difficult to administer chloroform to rabbits without exciting struggling or making them hold their breath.

December 10th.—No. 173.

Large pariah dog. Weight 34½ lbs. Chloroformed in the box at 10 h. 27 m. 38 s. Fell down at 10 h. 33 m. 45 s. Placed on the table at 10 h. 34 m. 2 s. and kept quiet with chloroform. Artery ligatured at 10 h. 38 m. 25 s. Canula inserted 10 h. 39 m. 45 s. Connexion with the manometer at 10 h. 46 m. 15 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 10 47 50.—Ordinary chloroform administration until the cornea became insensitive twice.
B. 10 54 35.—Injection of one grain of cocaine into the peritoneum.
C. 10 57 50.—Chloroform again until cornea became insensitive.
D. 11 6 15.—After the animal had come round, chloroform again, very gently but continuously, until death. Another injection of one grain of cocaine. After the respiration had stopped two curious rises of pressure with improved action of the heart took place (*vide* Fick readings 17 and 19).

December 10th.—No. 174.

Medium-sized pariah. Weight 24½ lbs. Temperature of the room 21½ Cent. Into chloroform box at 11 h. 34 m. 48 s. Fallen down at 11 h. 43 m. 7 s. Placed on the board at 11 h. 43 m. 20 s. and kept quiet with chloroform. Artery ligatured at 11 h. 48 m. 10 s. Canula inserted at 11 h. 49 m. 10 s. Temperature in the rectum 102° 8 F. Jugular vein ligatured at 11 h. 57 m. 10 s. Canula inserted into the jugular at 11 h. 58 m. 45 s. Connexion with the manometer at 12 h. 1 m. 45 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 12 2 20.—Chloroform administration while struggling and holding breath, but stopped almost immediately, after which the pressure fell considerably during a prolonged holding of the breath, but was restored to its former height by four deep slow inspirations, the cornea being still sensitive.
B. 12 5 30.—Chloroform again in the ordinary way three times, the third time until the cornea had been insensitive for a considerable time.
C. 12 15 40.—Chloroform again for a short time, and then at 12 h. 17 m. 0 s. injection of five minims of nicotine into the jugular vein. After this there was an immediate fall of pressure with irregularity and slowing of the heart's action (*vide* Fick 10), then very rapid heart's action and rise of pressure, and convulsions followed by a very rapid fall. Death ensued four minutes after the nicotine was thrown into the heart.

December 10th.—No. 175.

Large goat. Weight 60 lbs. Thrown and given chloroform at 2 h. 34 m. 40 s. Loop under both vagi. Artery ligatured at 2 h. 41 m. 40 s. Canula inserted at 2 h. 43 m. 17 s. Connexion with the manometer at 2 h. 50 m. 15 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 2 50 15.—Chloroform administration during struggling and holding the breath, which caused the usual fall in pressure. Chloroform was stopped after the pressure had risen again, and there was a well-marked after-fall.
B. 2 54 0.—Continued struggles and holding of the breath.
C. 3 0 0.—Chloroform again, very gently and without struggling, until the cornea became insensitive.
D. 3 6 50.—Chloroform gently and continuously until death. The respiration stopped at 3 h. 11 m. 0 s. and the heart at 3 h. 18 m. 0 s.

December 10th.—No. 176.

Smaller and rather thin goat, 46 lbs. Thrown and chloroformed at 3 h. 28 m. 30 s. Artery ligatured at 3 h. 43 m. 45 s. and canula inserted as usual. Connexion with the manometer at 3 h. 39 m. 20 s. One Ludwig and one Fick tracing during:—Continuous chloroform administration until death ensued with the cap closely pressed over the face. It shows the difficulty of killing an animal like the goat, which can persistently hold its breath for long periods. A very large quantity of chloroform was used.

December 11th.—No. 177.

Monkey. Weight 10 lbs. Into chloroform at 10 h. 47 m. 5 s. Fallen down at 11 h. 58 m. 30 s. Placed on the table at once and kept quiet with chloroform. Left carotid artery ligatured at 11 h. 6 m. 30 s. Canula inserted at 11 h. 9 m. 20 s., but the artery was accidentally cut across by the ligature and the canula could not be inserted again as the internal coats had collapsed. The left carotid was, therefore, tied above and below and abandoned. Right carotid artery ligatured at 11 h. 18 m. 7 s. Canula inserted at 11 h. 19 m. 27 s. Left vagus exposed and looped. Connexion made with manometer at 11 h. 25 m. 5 s. One Ludwig and one Fick tracing.

Observations.

- H. M. S.
A. 11 26 45.—Ordinary chloroform administration with struggles. (The trace is defective from kinks in the tube.)
B. 11 25 30.—Free chloroform administration while irritating the vagus. (The effect upon the vagus ceased before the electrodes were removed (*vide* Fick 5) and the chloroform was pushed until respiration ceased).
C. 11 32 0.—Artificial respiration.
D. 11 36 0.—Injection of ether, one drachm, into the peritoneum, which had an unexpectedly depressing effect, probably from the dose being excessive or the locality chosen for the injection unsuitable. (?)

The experiment was interrupted by the canula breaking while being cleared and cutting the artery, and the animal was killed with chloroform.

December 11th.—No. 178.

Dog that had ½ a grain of morphine hypodermically at 12 o'clock and another ½ grain at 2 o'clock. Put into chloroform box at 2 h. 1 m. 5 s. Fallen down at 2 h. 6 m. 30 s. Placed on the table at 2 h. 6 m. 55 s. and kept quiet with chloroform. Left carotid ligatured at 2 h. 13 m. 45 s. Canula inserted at 2 h. 14 m. 52 s. Connexion with the manometer at about 2 h. 18 m. 30 s. Three Ludwig and three Fick tracings. The object in this experiment was to ascertain if morphine had any effect in preventing the success of artificial respiration. Chloroform was given four times gently until respiration ceased and longer intervals were allowed to elapse each time before artificial respiration was commenced. On the first occasion a remarkable slowing of the heart was noticed just before and at the time the respiration stopped (*vide* Fick readings 2 and 3). Artificial respiration was commenced after about half a minute and natural respiration was soon restored. On the next occasion the heart completely stopped at the same time as the respiration (*vide* Fick reading 8), but soon commenced to beat again. Artificial respiration was begun nearly two minutes after the cessation of natural respiration, but this was again speedily restored. On the third occasion the heart again stopped at the same time as the respiration (*vide* Fick 13) and did not resume its beating for more than half a minute. After more than two minutes the animal made two feeble gasps, but artificial respiration was not begun until four minutes after the original stoppage. The pressure rose almost at once and natural respiration soon returned. On the fourth occasion there was again marked slowing of the heart's action shortly after respiration had stopped (Fick 18). Artificial respiration was begun after two minutes and a half and was successful in restoring the natural respiration. After recovery the chloroform was again pushed rapidly and continued until death resulted without any attempt to restore the animal by artificial respiration. There was again some slowing and intermittence of the heart's action (*vide* Fick 26), but the heart continued to beat for eight minutes after the cessation of the respiration.

Observations.

- H. M. S.
A. 2 19 45.—Chloroform. Respiration became very slow at 2 h. 21 m. 10 s. At 2 h. 22 m. 0 s. the pupils were both dilated and at 2 h. 24 m. 40 s. the respiration stopped. This was immediately followed by a long cessation of the action of the heart; there was then one full beat and the very slow action which is recorded in Fick reading 3. It is to be observed that the cessation of the heart's action was not followed by any further fall of the blood-pressure, and that the pulsations on each side of the pause were ample and strong; in short, there was arrest, but there was no failure of the heart. Artificial respiration was resorted to at 2 h. 25 m. 25 s., though there is no doubt the animal would have revived without it.
B. 2 29 25.—Chloroform. At 2 h. 33 m. 0 s. the respiration became very irregular, and ceased at 2 h. 34 m. 30 s. At the same moment the heart stopped completely (*vide* Fick 8). It recommenced to beat very quickly, but there was a second and shorter arrest, recorded on the Ludwig tracing. Artificial respiration was employed at 2 h. 36 m. 30 s., but it was unnecessary as the animal would have recovered without it.
C. 2 51 40.—Chloroform. The respiration was thought to have stopped at 2 h. 53 m. 40 s., but did not actually stop till 2 h. 54 m. 45 s. The heart stopped at the same moment for more than a minute. Breathing recommenced at 2 h. 57 m. 0 s., but at 2 h. 58 m. 0 s. the pressure fell again and artificial respiration was resorted to at 2 h. 58 m. 40 s. The blood-pressure rose rapidly and natural breathing recommenced at 3 h. 1 m. 0 s.
D. 3 7 25.—Chloroform with plenty of air. The respiration stopped at 3 h. 14 m. 0 s. Artificial respiration was commenced at 3 h. 16 m. 30 s. and the animal soon breathed naturally, which he would probably have done without artificial respiration.
E. 3 25 0.—The animal was still stupefied from the effect of the previous dose of chloroform when this observation was commenced. Chloroform was administered freely with a closely applied cap. Respiration stopped at 3 h. 32 m. 40 s., and the heart ceased to beat at 3 h. 40 m. 25 s.

Experiment 178 is very like Experiment 162 in which the heart's action was temporarily arrested every time the respiratory centre was paralysed. As in 162 there was no further fall of blood-pressure during the arrest, and the beats on each side of the stop were ample and strong. The most remarkable instance of this is seen at Fick 13. For more than 2 minutes there were only 17 very slight pulsations recorded, and for over a minute of this reading there was no pulsation at all. There was no fall of pressure during the arrest, and the Ludwig tracing shows how strong the beats on each side of it were. No better proof could be afforded than is to be found in these two experiments that direct weakening of the heart is not the cause of the fall of the blood-pressure which is inseparable from chloroform narcosis.

Experiments 64, 65, 162, 178 and 186 prove three important points:—

- I.—A general fall of blood-pressure, whether sudden or gradual, is not in itself dangerous. (This is confirmed by the tracings of the Glasgow experiments).
- II.—The fall of blood-pressure, which occurs in chloroformisation with regular breathing, is due solely to narcosis of the vaso motor system, and is, if not a safeguard, absolutely harmless.
- III.—The fall of the blood-pressure under chloroform is not due to weakening of the heart. The heart has nothing to do with producing it, unless the vagus is stimulated, or unless its nutrition fails either from imperfect oxygenation of the blood due to abnormal breathing, or from stoppage of the respiration from over-dosing.

December 13th.—No. 179.

Temperature of the room 20.5 Cent. Monkey small-sized. Weight 7 lbs. Chloroform given in box at 11 h. 17 m. Fallen down at 11 h. 30 m. 10 s. and placed on the board. Artery ligatured at 11 h. 40 m. Trachea opened and tube inserted into it. Canula inserted into artery at 11 h. 46 m. Two Ludwig and one Fick tracings during—Continued very gradual administration of chloroform by dropping it into a funnel lined with blotting paper, which was connected by a tube with an opening in a large bottle. A second opening in the bottle was joined by a tube to the trachea, while a third opening was connected with a Marey's tambour registering on the slow Ludwig drum (*vide* Ludwig tracing).

The respiration stopped at 12 h. 36 m. 5 s. and the heart ceased at 12 h. 42 m.

December 13th.—No. 180.

Medium-sized monkey, 9 lbs. Into chloroform box at 2 h. 46 m. Fallen down at 2 h. 58 m. 3 s. and placed at once on the table. Trachea opened and tube inserted. Artery ligatured and canula inserted. Connexion made with the manometer 3 h. 14 m. 45 s. The experiment was prevented by the soda solution exuding out of the tracheal tube and killing the animal by convulsions and oedema of the lungs. The pressure in the manometer before the experiment was exactly that of the blood when connexion was made (*vide* Ludwig tracing). The canula was correctly placed in the artery and had not cut it. The tracheal tube was also quite perfectly fixed. There was a lot of fluid in both pleural cavities. Lungs oedematous and one base carnified. Both the cavities of the heart contained a light coloured alkaline fluid. Peritoneum also full of similar fluid. The fluid from the trachea was strongly alkaline and effervesced freely on adding hydrochloric acid, and when tested with perchloride of mercury it gave a brown precipitate resembling that given by the soda solution when similarly tested. The only possible explanation of this case seems to be that communication had been accidentally made between the artery and the vein by which means the animal was injected with the soda solution.

December 13th.—No. 181.

Monkey, weight 7½ lbs. Into chloroform box at 4 h. 2 m. 45 s. Fell down at 4 h. 11 m. 40 s. Artery ligatured at 4 h. 20 m. 45 s. Trachea opened at 4 h. 23 m. and a tube tied into it. Canula inserted into the artery at 4 h. 25 m. 20 s. Chloroform at 4 h. 27 m. 45 s. Connexion with manometer at 4 h. 30 m. One Ludwig and one Fick tracing during gradual administration of chloroform through the same bottle as in 179. Respiration stopped at 4 h. 44 m. 45 s. and the heart ceased acting at 4 h. 52 m.

December 14th.—No. 182.

Monkey, weight 9 lbs. Into the chloroform box at 7 h. 42 m. 40 s. Fallen down at 7 h. 51 m. 10 s. and at once placed on the table. Kept quiet with chloroform from time to time. Artery ligatured at 7 h. 59 m. 3 s. Trachea opened and canula inserted at 8 h. 3 m. 30 s. Canula inserted into the artery at 8 h. 10 m. 3 s. Connexion with manometer at 8 h. 14 m. Two Ludwig and one Fick tracing.

Observations.

- A. 8 16 20.—Administration of alcohol, without any effect whatever.
- B. 8 23 30.—Administration of ether very gradually through the bottle apparatus used in 179. Respiration ceased at 8 h. 50 m. 30 s. Heart stopped at 8 h. 56 m. 0 s.

December 14th.—No. 183.

Dog, weight 30 lbs., that has had 2 grains of phosphorus this morning. Into chloroform box at 2 h. 3 m. 40 s. Fallen down at 2 h. 9 m. 15 s. Placed on the table and kept quiet with chloroform. Artery ligatured at 2 h. 14 m. Canula inserted at 2 h. 16 m. 40 s. Connexion made with manometer at 2 h. 20 m. 10 s. Two Ludwig and three Fick⁹ tracings.

⁹ Speed of the Fick drum increased in this experiment, so that it made a complete revolution in 1 m. 9 s.

Observations.

- H. M. S.
- A. 2 23 45.—Chloroform administration on a saturated cap closely applied, during which the animal held its breath and an unusually well-marked fall of pressure occurred. The Fick apparatus was unfortunately not ready at this time. The chloroform was stopped as soon as the animal began to gasp to prevent any danger of over dosing.
- B. 2 23 25.—Chloroform administration in the same way repeated twice in the hope of obtaining a similar tracing on the Fick drum, but the animal did not hold its breath rigidly as in the first instance, and there was only an occasional slight slowing of the pulse (Fick I and 2).
- C. 2 27 35.—Artificial respiration.
- D. 2 31 30.—Salivation and some accumulation of fluid in the trachea.
- L. 2 35 15.—Injection of 30 minims of liquor atropinæ into the peritoneal cavity.
- F. 2 40 0.—Irritation of first the left and then the right vagus to show that the atropine had taken effect.
- G. 2 45 30.—Smothering by holding the nose and mouth.
- H. 2 51 0.—Chloroform again freely, but the animal neither struggled nor held its breath, owing probably to the obstructed condition of the trachea or to the weak state of the animal after phosphorus; recovery was very slow.
- I. 3 3 25.—After the animal had come quite out and had begun to struggle, chloroform was again given very freely. The animal held its breath, but no marked slowing of the heart or fall of pressure occurred. Chloroform was finally pushed until death resulted.

December 16th.—No. 184.

Dog, weight 29 lbs., that has had two grains of phosphorus (one yesterday and one the day before) and was rather feeble in consequence. Chloroform given at 7 h. 35 m. 45 s. Fallen down and placed on the table at 7 h. 42 m. Kept quiet with chloroform. Artery ligatured at 7 h. 51 m. Trachea opened and tube inserted. Canula inserted into the carotid at 7 h. 59 m. Connexion made with the manometer at 8 h. 5 m. 30 s. Two Ludwig and three Fick tracings.

Observations.

- H. M. S.
- A. 8 11 25.—Blowing up the chest forcibly by means of a bellows attached to the tracheal tube; repeated three times.
- B. 8 17 10.—Exhausting the air in the chest with bellows.
- C. 8 24 40.—Production of asphyxia by stopping up the trachea; repeated.
- D. 8 37 0.—Injection of 30 minims of liquor atropinæ into peritoneal cavity.
- E. 8 41 40.—Blowing up the chest again repeatedly.
- F. 8 59 0.—Stopping up the trachea again. After the atropine, fall of pressure still occurs in inflation of the chest, but no slowing of the heart (*vide* Fick 8 and 9). The slowing of the heart during asphyxia is also abolished. (Compare No. 158).
- G. 9 1 40.—The animal was finally killed with chloroform.

December 16th.—No. 185.

Dog, weight 36 lbs., unpoisoned and healthy. Into the chloroform box at 2 h. 30 m. 35 s. Fallen down at 2 h. 36 m. Placed on the table at 2 h. 36 m. 15 s. Foaming at the mouth and kept quiet with chloroform. Artery ligatured at 2 h. 42 m. 30 s. Canula inserted at 2 h. 43 m. 25 s. Connexion with manometer at 2 h. 49 m. 20 s. Two Ludwig and five Fick tracings.

Observations.

- H. M. S.
- A. 2 51 0.—Struggling and repeated holding of the breath when he was quite out of chloroform.
- B. 2 59 45.—Holding an ordinary cap with ammonia on it before the nose.
- C. 3 1 20.—Chloroform administration during struggling and holding of the breath.
- D. 3 5 20.—Snipping the anus.
- E. 3 7 0.—Pulling out the tongue forcibly, which had the effect of making him hold his breath, and produced a fall of the blood-pressure and stoppage of the heart (*vide* Fick 5).
- F. 3 11 0.—Chloroform during violent struggling.
- G. 3 22 0.—Pushing chloroform until respiration stopped.
- H. 3 31 20.—Squint operation. No effect.
- I. 3 34 0.—Chloroform pushed until death resulted.

N.B.—The Fick drum was revolving in 1 m. 9 s. in this and the previous experiment. In all experiments before 183 the Fick revolution occupied 3 m. 9 s.

Remarks.—Experiment 185 shows the irregularity of the blood-pressure which is produced by struggling and holding the breath when the subject is or is not under the influence of chloroform. It also shows the fall of pressure and slowing of the circulation produced by forcibly pulling forward the tongue (*vide* Ludwig I. at 3.4 and 3.7, and Fick III.). (See pages 68 and 70.) This is constantly done when patients are in danger from an overdose of chloroform, and was the only operative procedure in the Commission's experiments which caused the same effect as electrical irritation of the vagus. During the 185th experiment many operations were performed, with a view to induce shock without any effect upon the heart, the pulse, or the blood-pressure.

March 6th, 1890.—No. 186.

Healthy dog, weight 20 lbs. Temperature of room 28 Cent. Chloroform given in box 1 h. 58 m. 30 s. Dog fallen down at 2 h. 4 m. Dog on table at 2 h. 5 m. Artery ligatured at 2 h. 10 m. 30 s. Canula inserted at 2 h. 12 m. 30 s. Connexion with manometer made 2 h. 16 m. 30 s.

Observations.

- H. M. S.
- A. 2 17 50.—Electrical irritation of entire vagus, coil 5, for 30 seconds. This observation shows the harmless effect of sudden lowering of the blood-pressure.
- B. 2 18 40.—Normal chloroform administration with regular respiration. The fall of the blood-pressure was perfectly regular and gradual. The breathing stopped at 2 h. 24 m. 0 s., the vagus was stimulated at 2 h. 24 m. 15 s. with the effect of slowing the pulse; and the animal was restored without any other treatment.
- C. 2 35 45.—Irritation of entire right vagus, coil 5, and simultaneous chloroform inhalation. The breathing stopped at 2 h. 37 m. 12 s., and was restored without artificial respiration at 2 h. 39 m. 0 s. The vagus stimulation was stopped at 2 h. 39 m. 5 s. and the animal quickly recovered. The effect of the vagus stimulation was to suddenly lower the blood-pressure almost to zero, and chloroform was pushed while the pressure was low. If lowering the pressure were a danger with chloroform, this administration ought to have been particularly dangerous; but the fall of pressure, with stoppage of the respiration, was obviously a safeguard, as the animal recovered without artificial respiration or any other measures being taken to revive it.
- D. 2 48 25.—Repetition of Observation A for over a minute
- E. 2 53 32.—Chloroform inhalation with regular breathing. The respiration ceased at 2 h. 56 m. 0 s. The entire right vagus was stimulated from 2 h. 56 m. 10 s. to 2 h. 57 m. 25 s. The breathing recommenced at 2 h. 57 m. 20 s. and the administration of chloroform was continued for thirty seconds afterwards. The animal recovered without artificial respiration or other treatment. In this

H. M. S.

- observation the stimulation of the vagus: after respiration had entirely stopped from over-dosing with chloroform and the blood-pressure was very low: had the effect of still further lowering the pressure, and of keeping it nearly at zero, with a slow pulse, for over a minute. If the fall of pressure were in itself a danger under chloroform, the further fall ought to have increased the danger; but it proved to be a safeguard and saved the animal's life.
- F. 3 6 0.—Ordinary chloroform inhalation; Interrupted to change the drum.
- G. 3 13 40.—Ordinary chloroform inhalation pushed till the animal died. The breathing stopped at 3 h. 15 m. 50 s.; there was slight vaso motor recovery at 3 h. 18 m. 0 s.; the pulse began to fall at 3 h. 19 m. 25 s.; a needle was inserted into the heart at 3 h. 20 m. 45 s., and continued to move strongly and rhythmically until 3 h. 23 m. 0 s. In this observation the animal was left entirely alone after the respiration ceased, and it died.

In Experiment 186 it might be said that the animal's recovery in Observation E was due to the vagus being entire, and to consequent stimulation of the respiratory centre when the nerve was irritated. But in the first place the respiratory centre was paralysed by chloroform, and until the effect passed off it could not respond to any stimulus; and in the second place, if the recovery was due to stimulation of the respiratory centre in Observation E, it must have been due to paralysis of the respiratory centre in Observation C, which is impossible. Observation E clearly shows that the fall of the blood-pressure under chloroform is not due to weakening of the heart. As in No. 178, the beats of the heart on each side of the inhibition were ample, and became smaller as the pressure rose during recovery, which could not be the case if the organ were weakened and the fall of the blood-pressure were due to this cause.

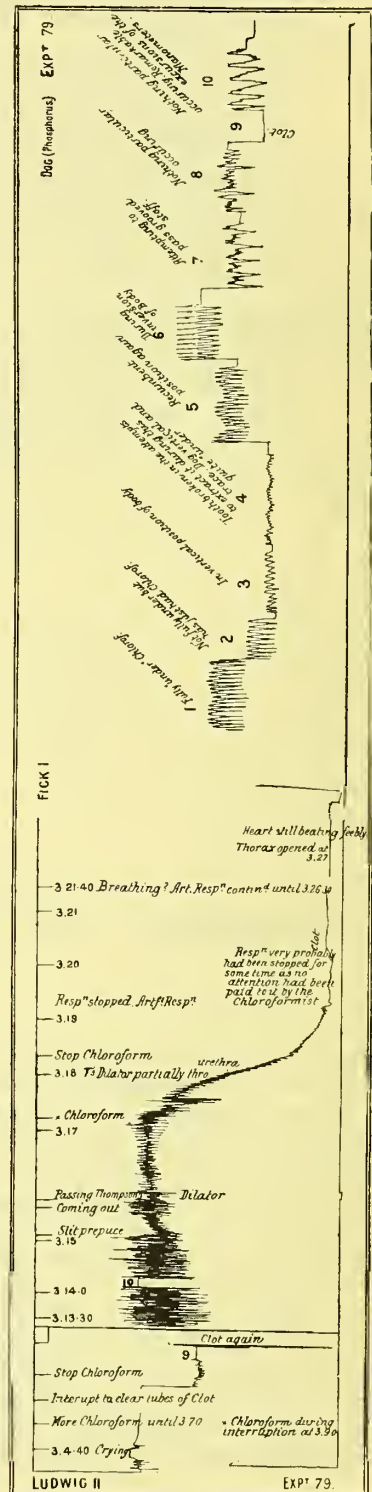
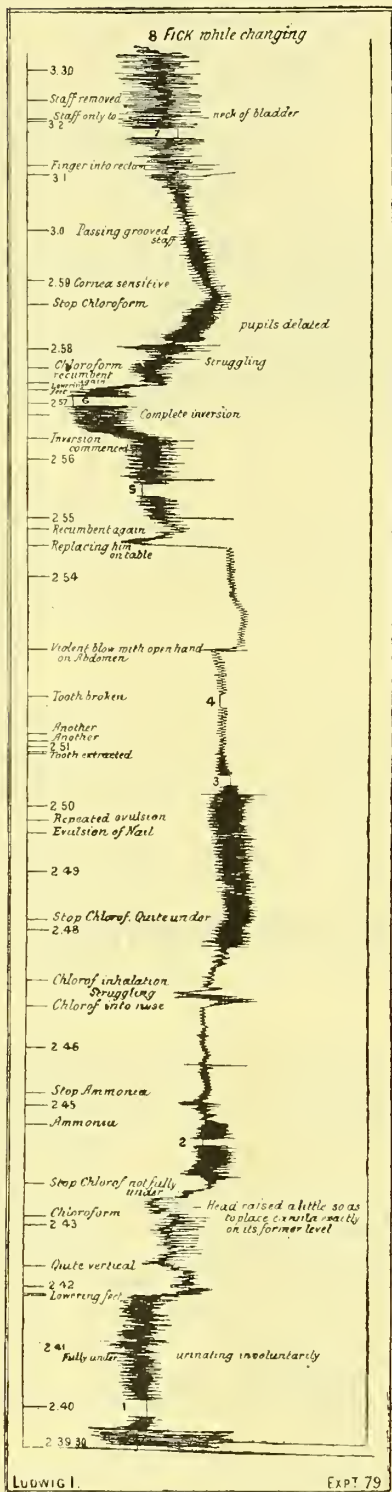
TRACINGS OF MANOMETER EXPERIMENTS.

The tracings which we have reproduced were taken by connecting the carotid artery of the animal with a mercurial manometer, the float of which ascended and descended with every rise or fall in the arterial pressure, and traced upon the slowly revolving cylinder blackened with soot the variations of the pressure upon the arterial system. As the revolutions of the cylinder were too slow to allow of the individual pulse beats being seen, a second cylinder was employed which revolved at a speed nearly ten times as great as the first; by using a wide tube either limb of which could be shut off or opened at leisure, both manometers could either be put into communication at once with the artery, or a single one could be connected at a time. Usually only one was thus connected; the general variations of the arterial pressure are

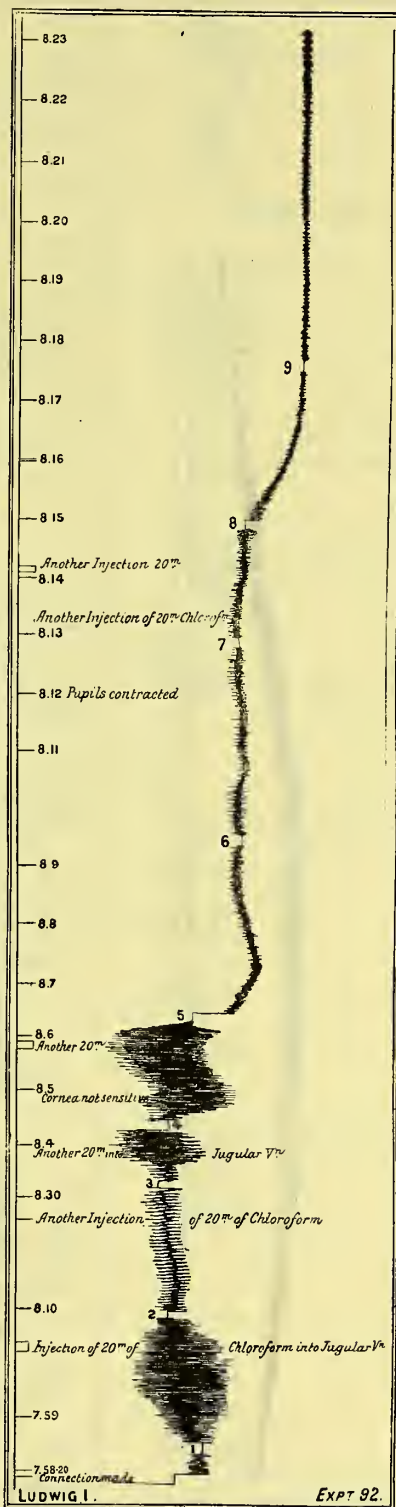
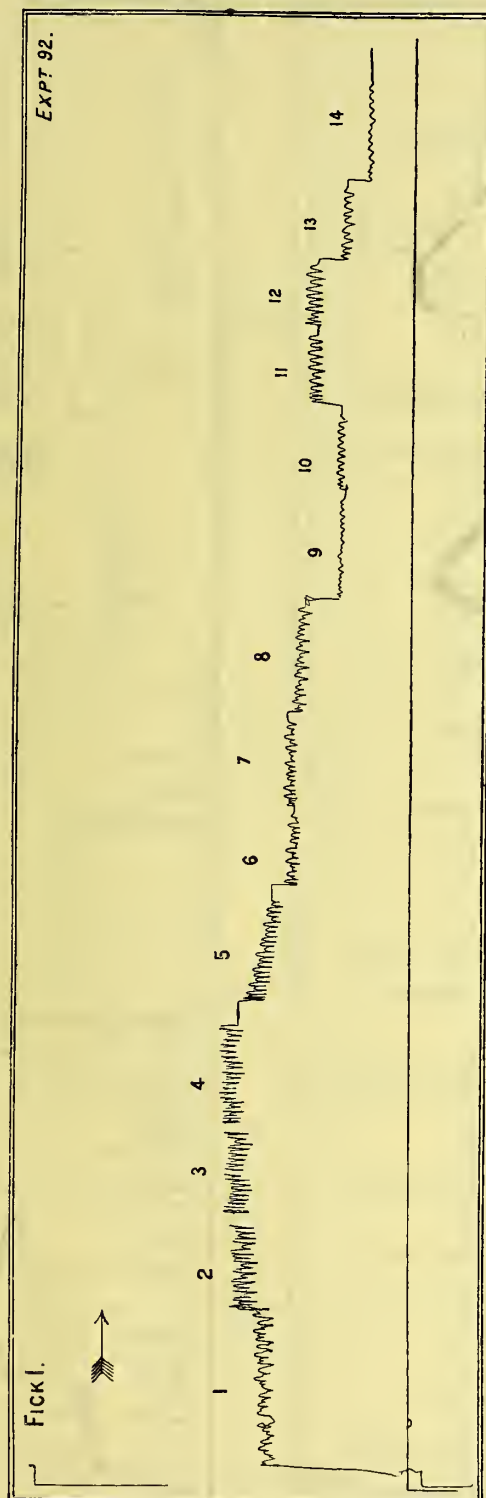
shown in the tracing taken by the Ludwig's or mercurial kymograph, termed shortly "Ludwig" in the tracings, and the pulse beats were taken by a Fick's kymograph on the quickly revolving cylinder. These tracings are indicated by the word "Fick" in the corner. In the tracings taken by Ludwig's manometer a straight line will be found here and there in place of the usual curve. These lines indicate the points where the Fick's kymograph was connected with the artery in place of Ludwig's. Each is numbered, and by reference to the corresponding tracings by Fick's kymograph the character and rate of the pulse at any of these periods can be readily ascertained.

A fuller description of the method of experimentation is given at p. 10.

NOVEMBER 12TH.—EXPERIMENT 79.

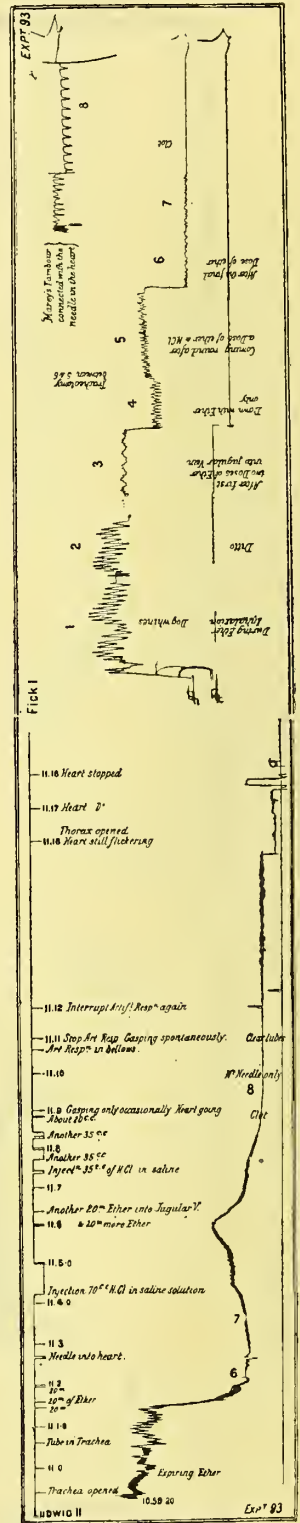
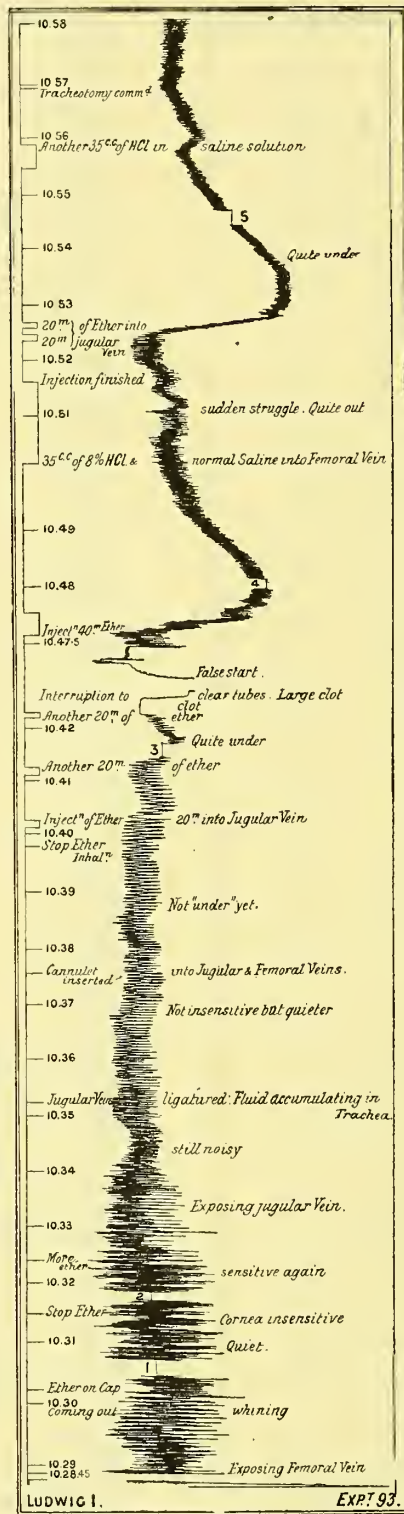
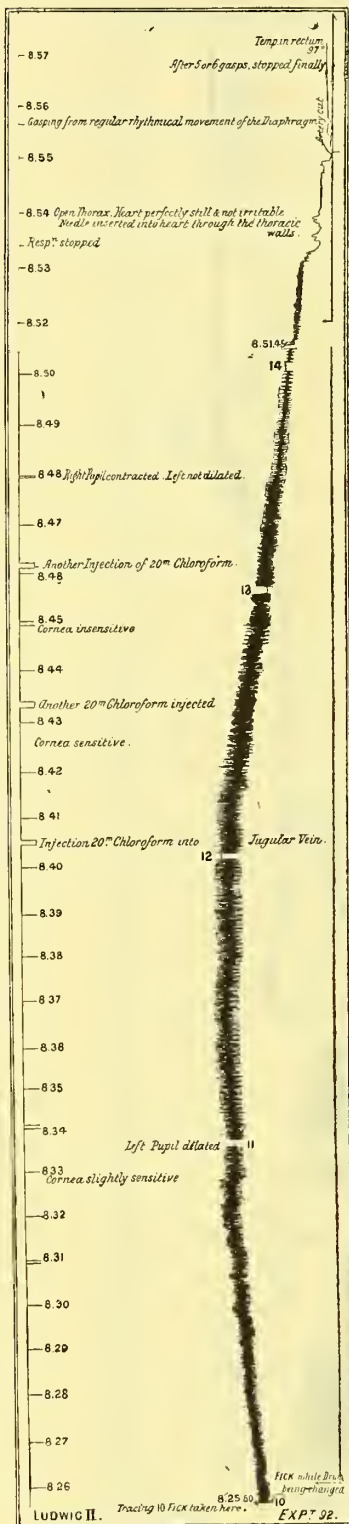


NOVEMBER 18TH.—EXPERIMENT 92.

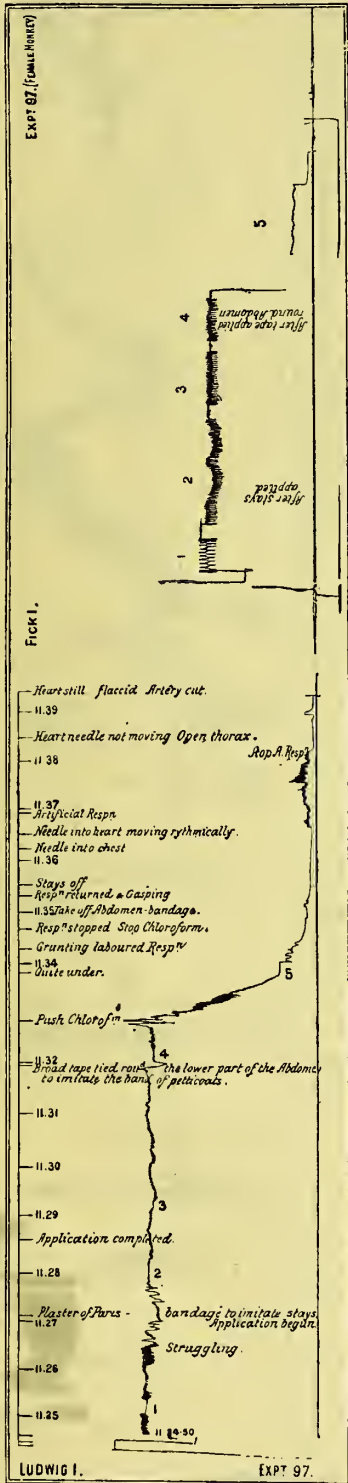


EXPERIMENT 92 (continued).

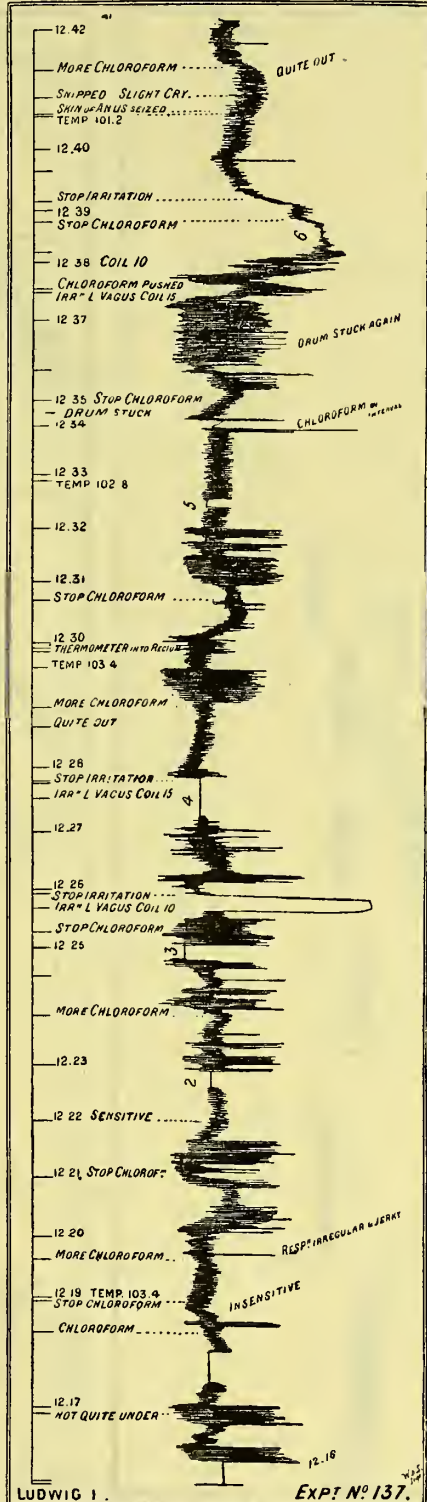
NOVEMBER 18TH.—EXPERIMENT 93.



NOVEMBER 19TH.—EXPERIMENT 97.

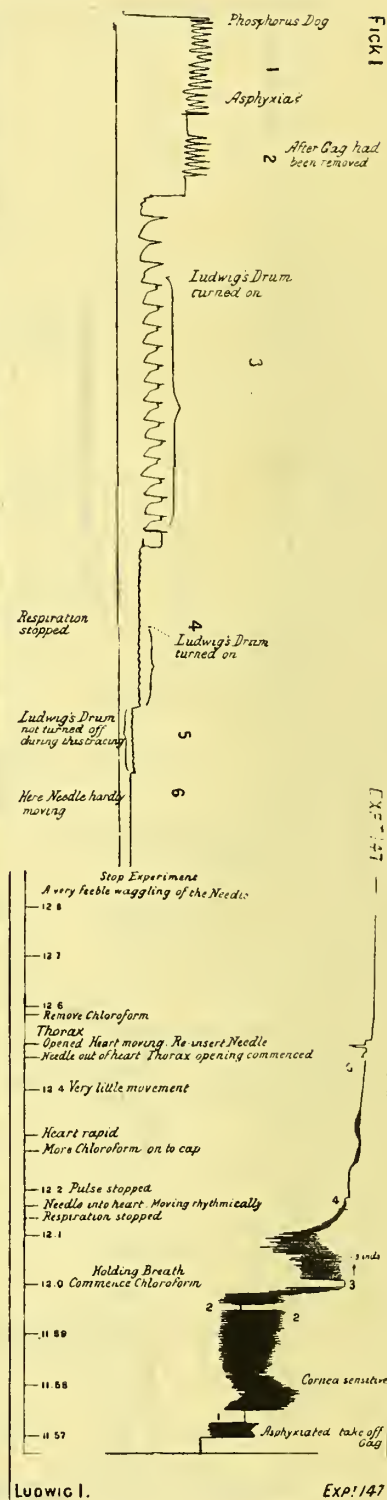
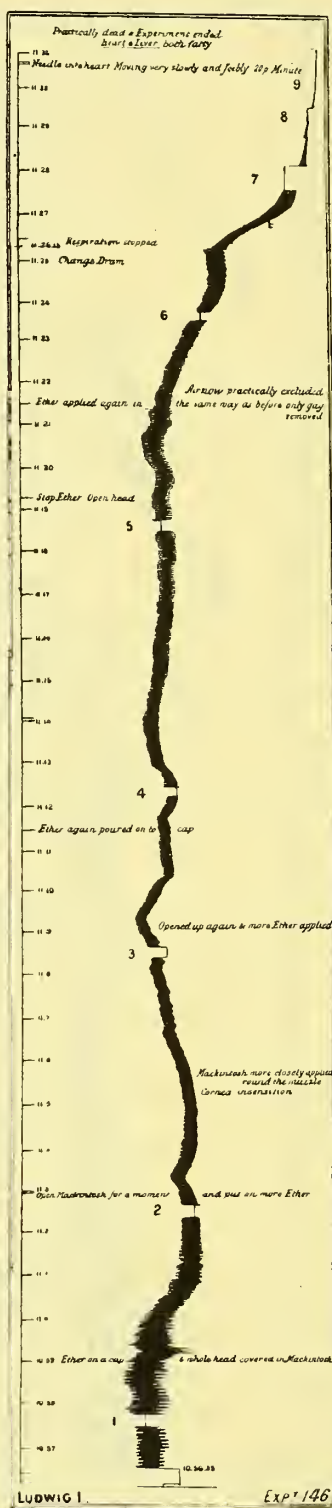
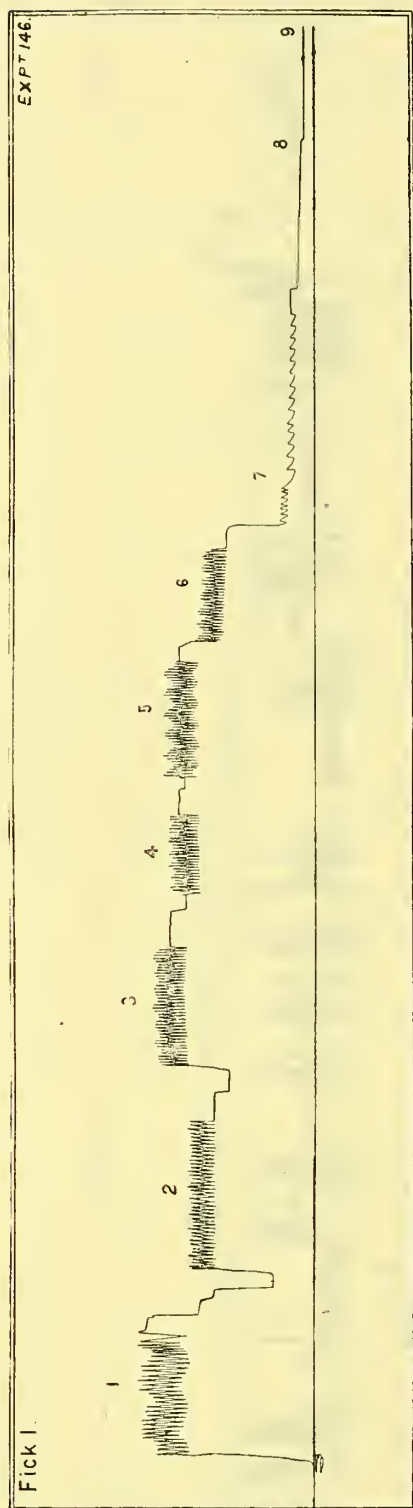


NOVEMBER 28TH.—EXPERIMENT 137.

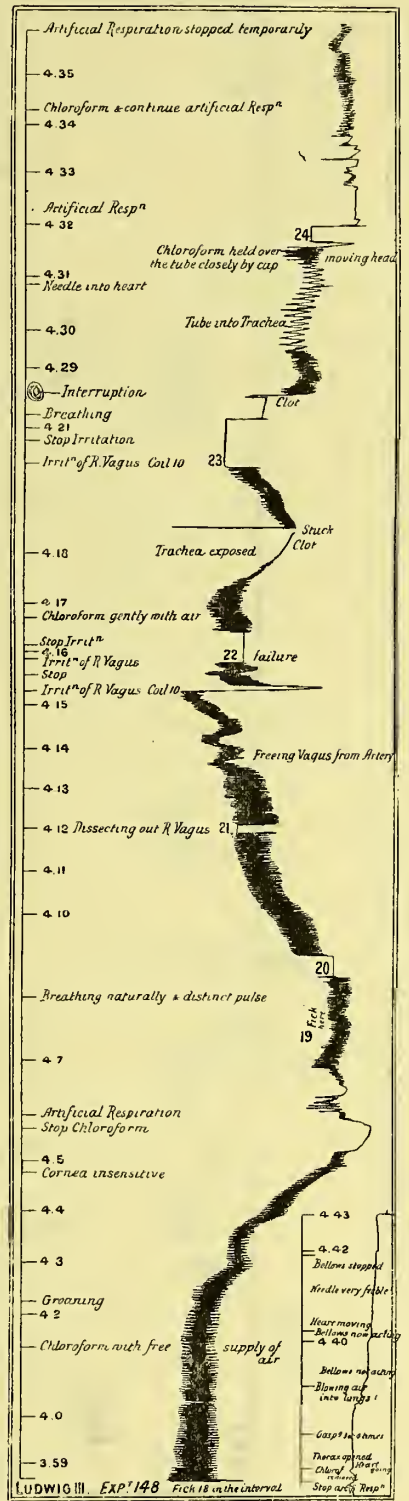
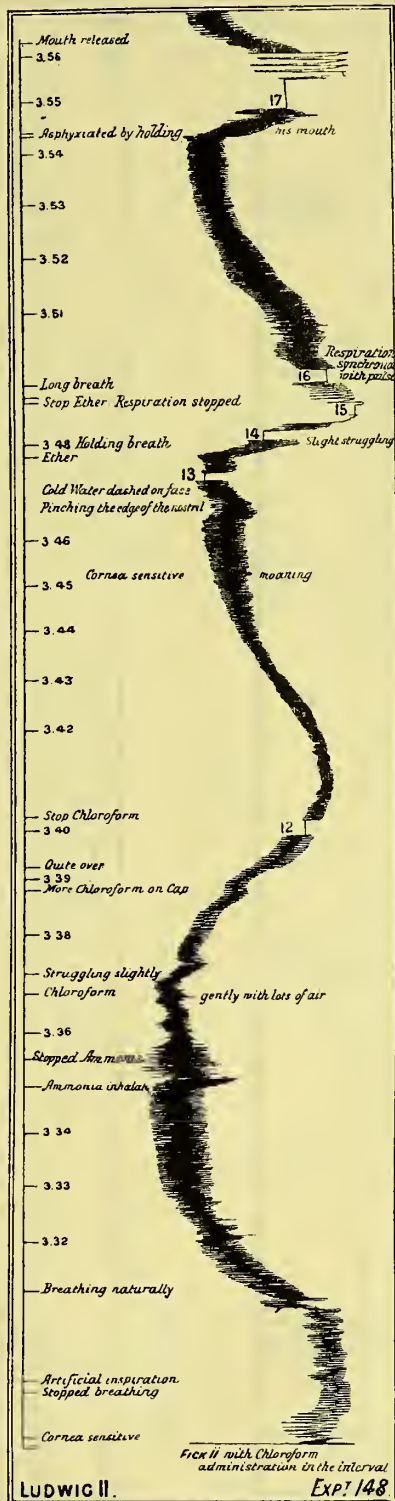
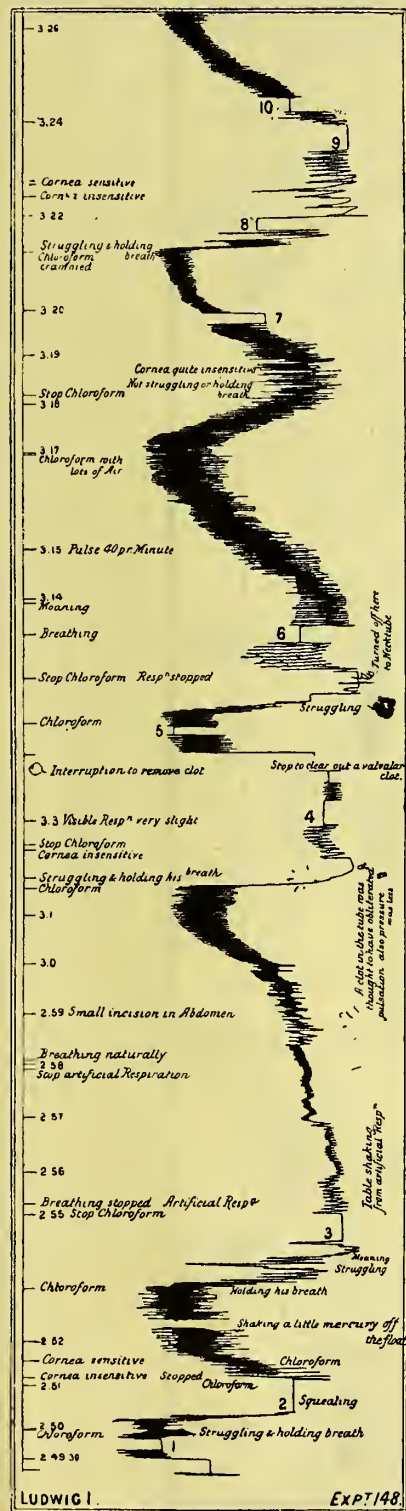


NOVEMBER 30TH.—EXPERIMENT 146.

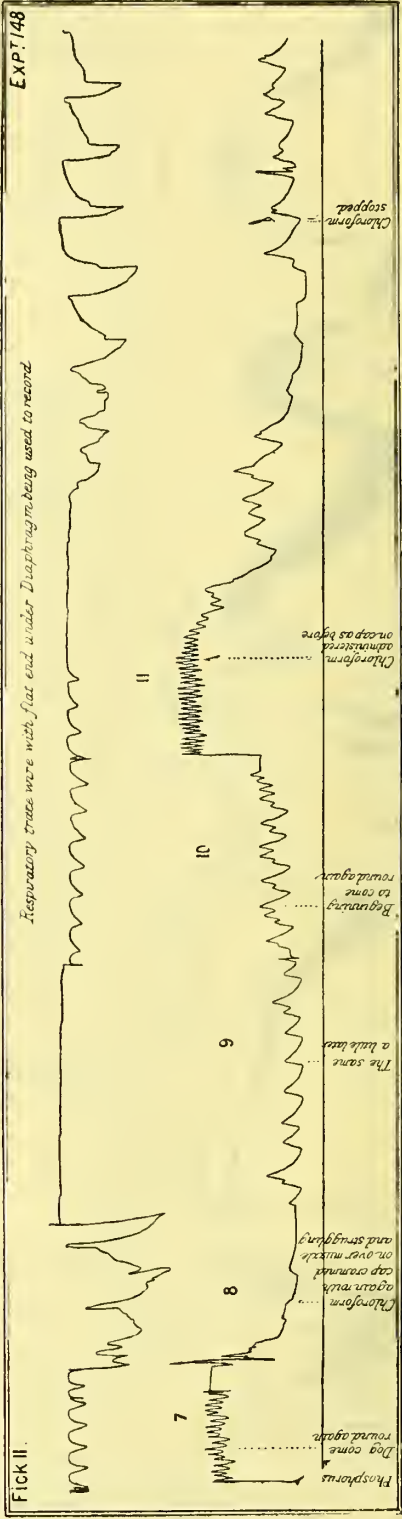
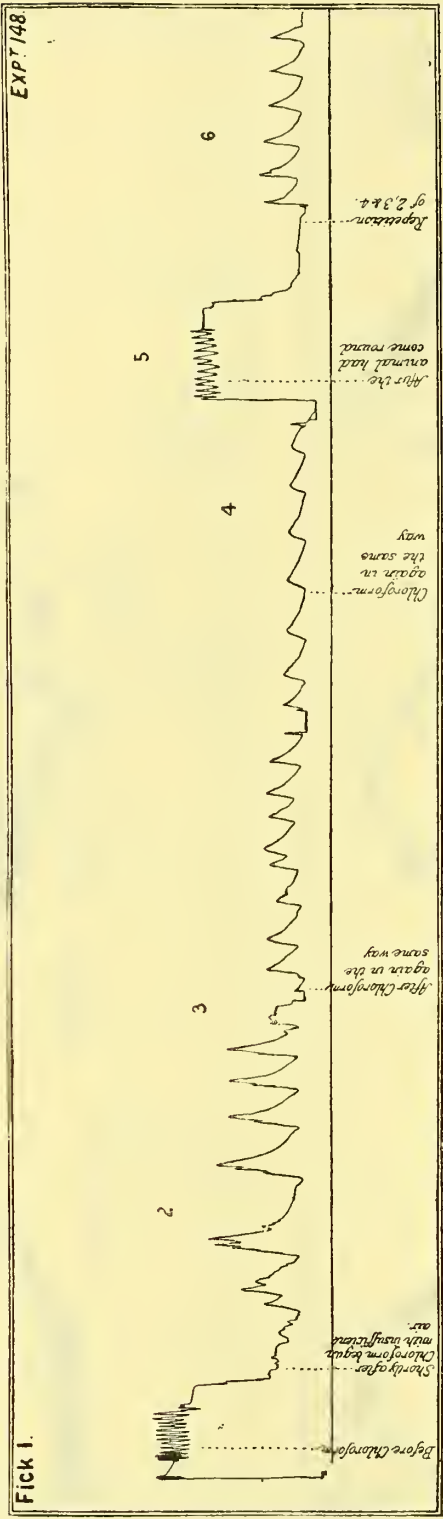
NOV. 30TH.—EXPERIMENT 147.



NOVEMBER 30TH—EXPERIMENT 148.

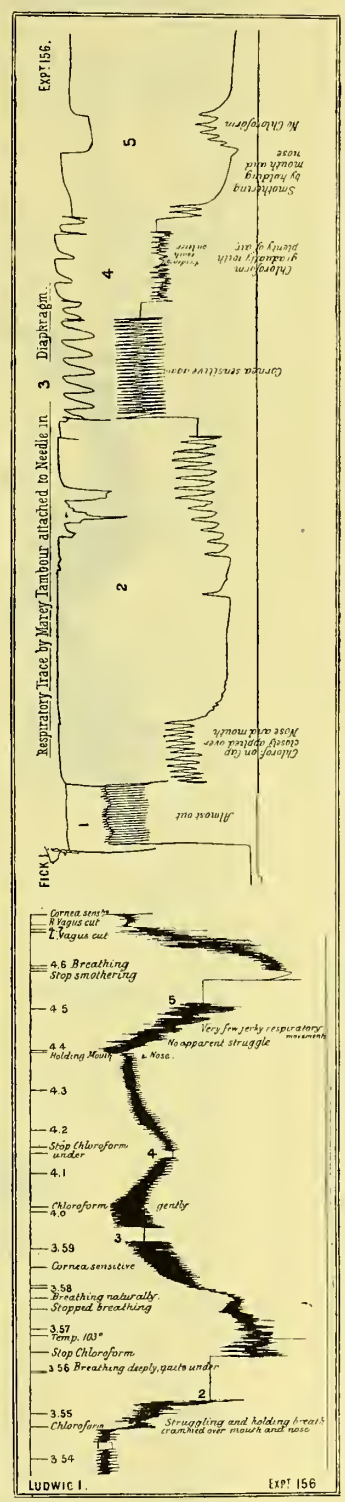
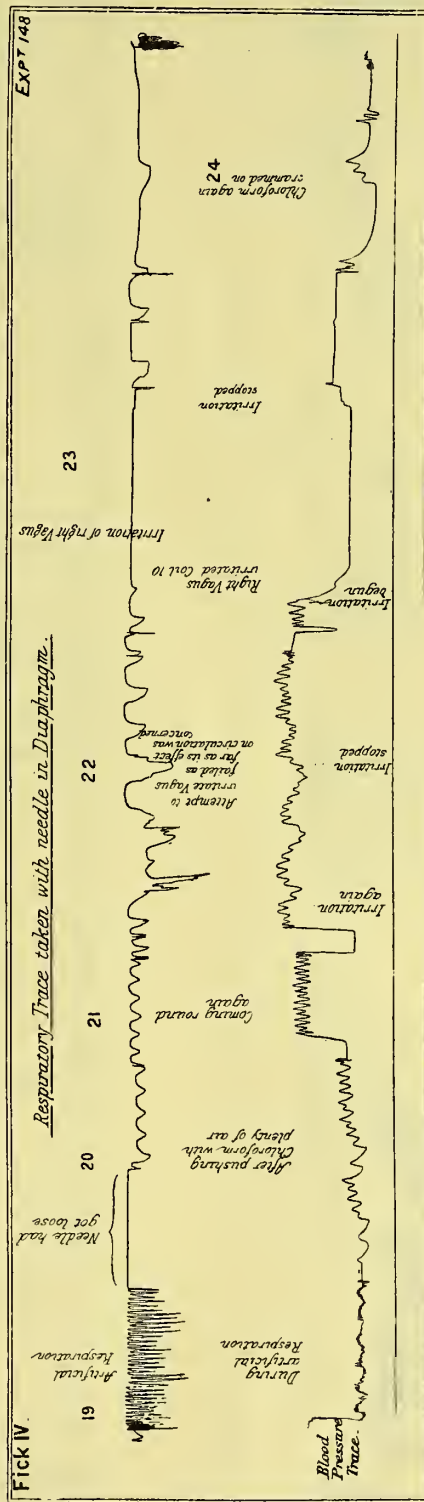
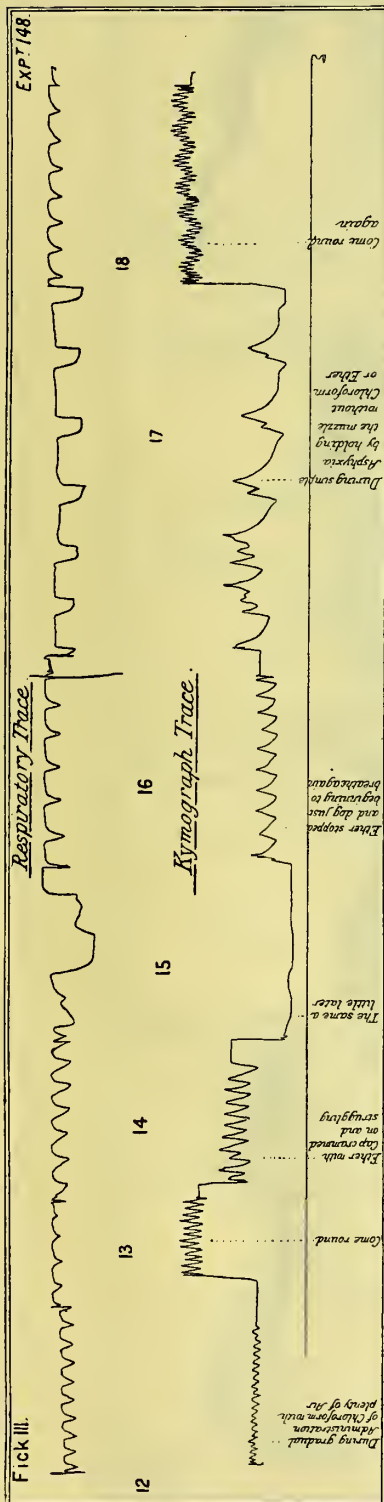


EXPERIMENT 148 (continued).



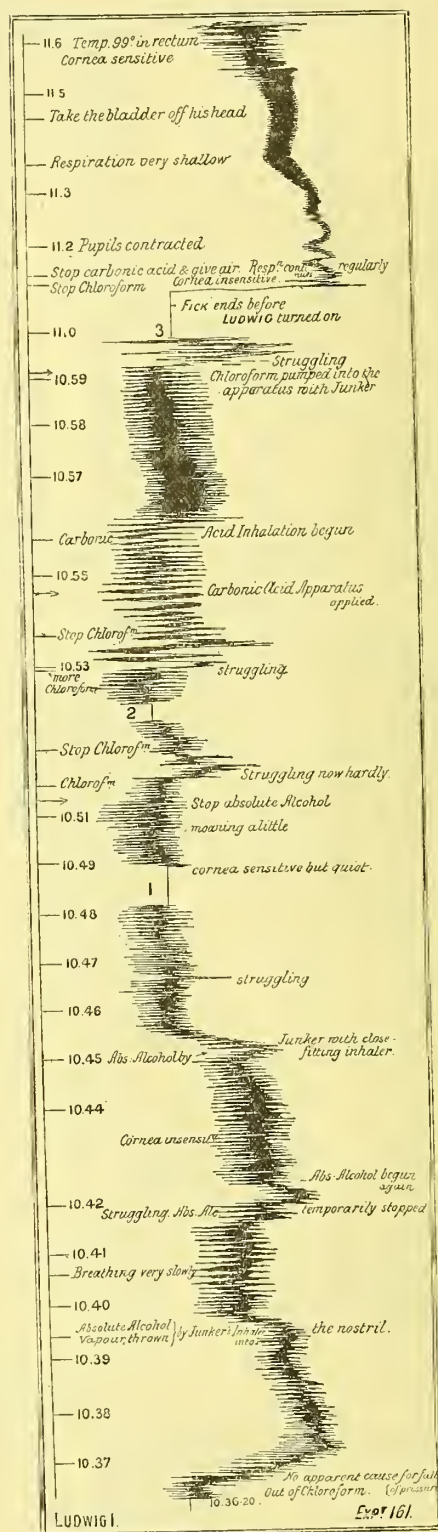
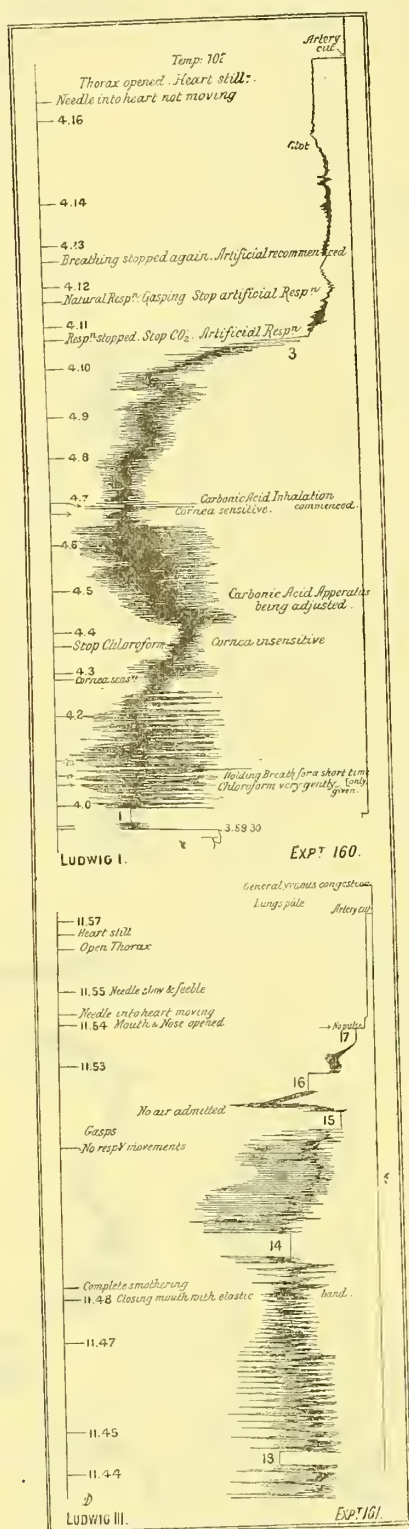
EXPERIMENT 148 (continued).

DEC. 3.—EXPERIMENT 156.

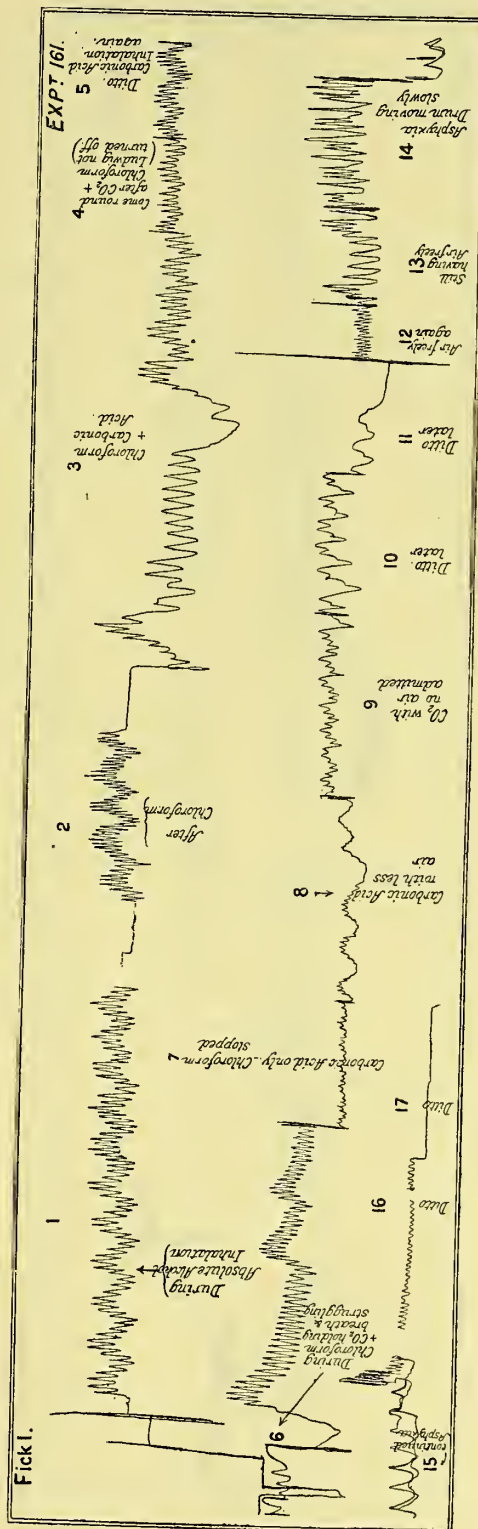
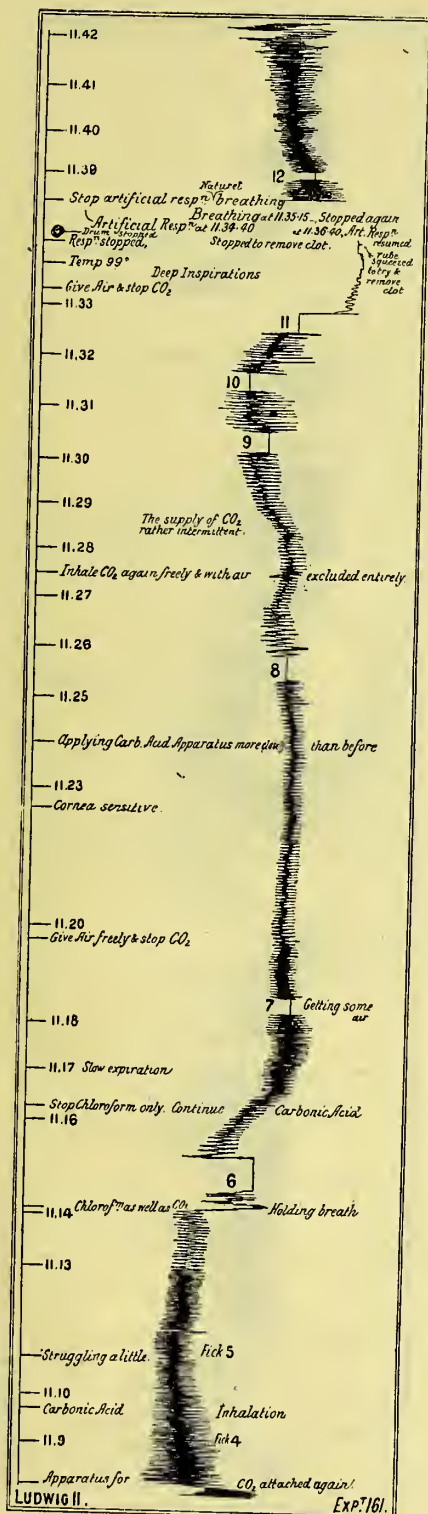


DEC. 4TH.—EXP. 160. DEC. 6TH.—EXP. 161.

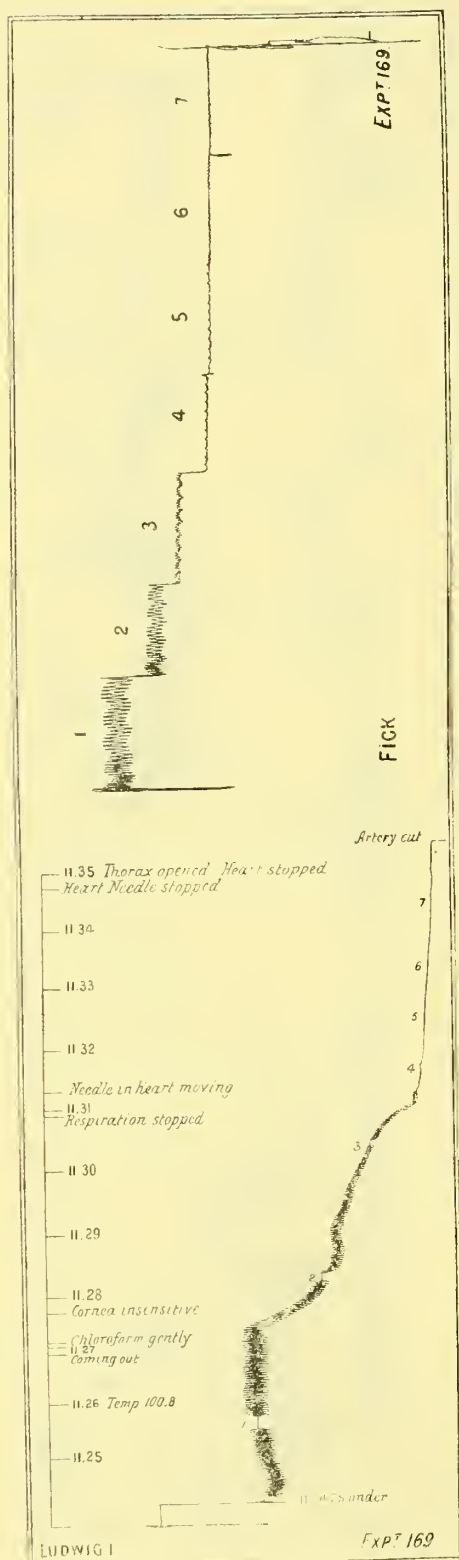
EXPERIMENT 161 (continued)



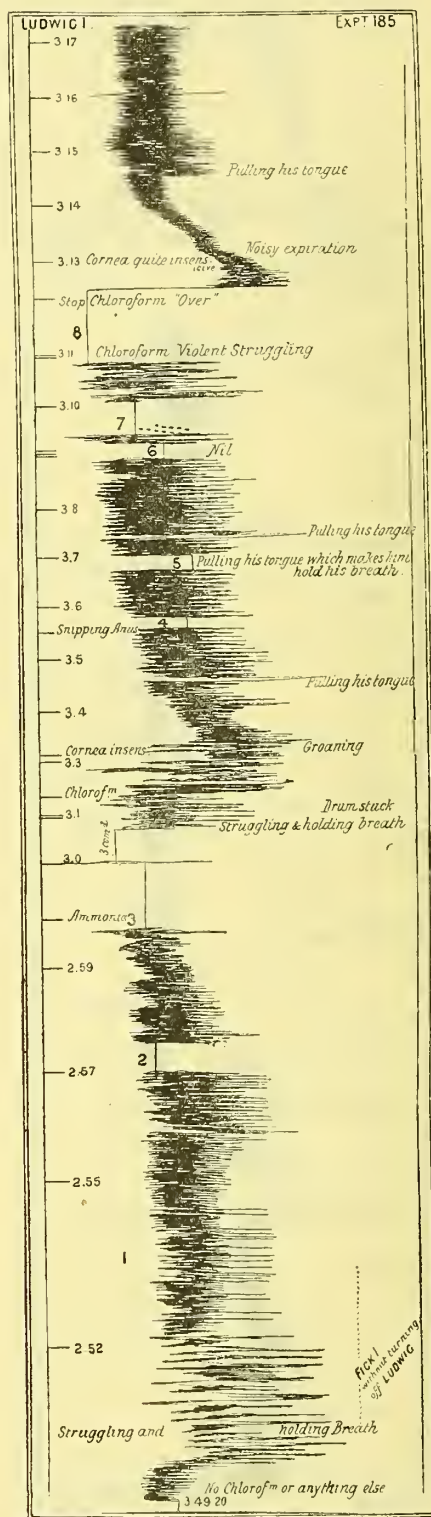
EXPERIMENT 161 (continued).



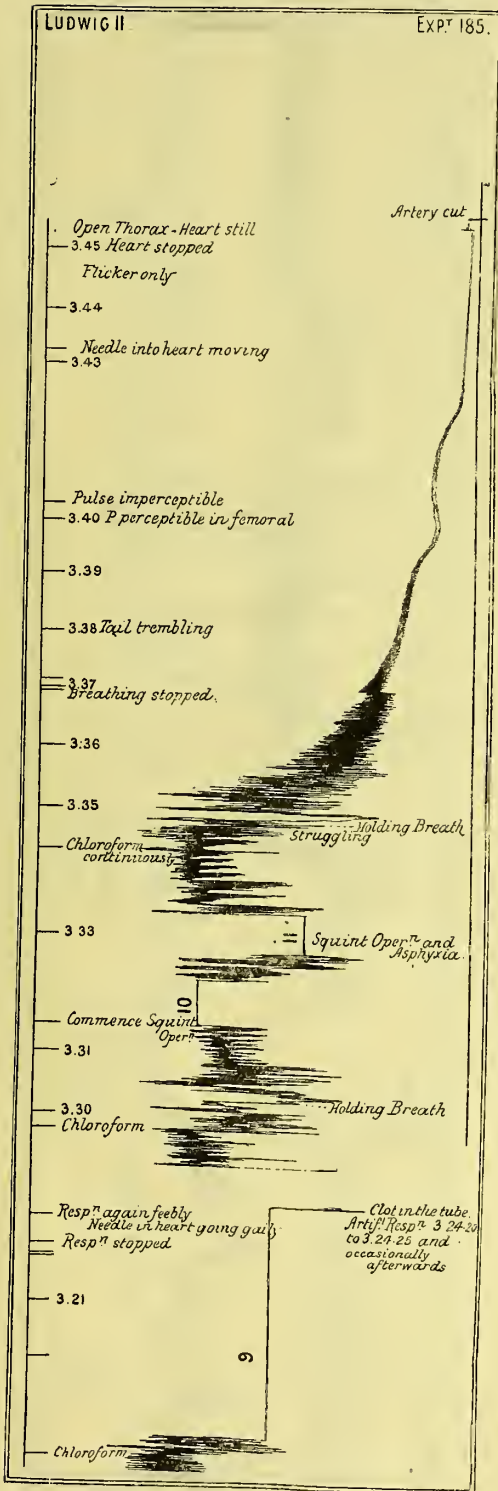
DECEMBER 9TH.—EXPERIMENT 169.



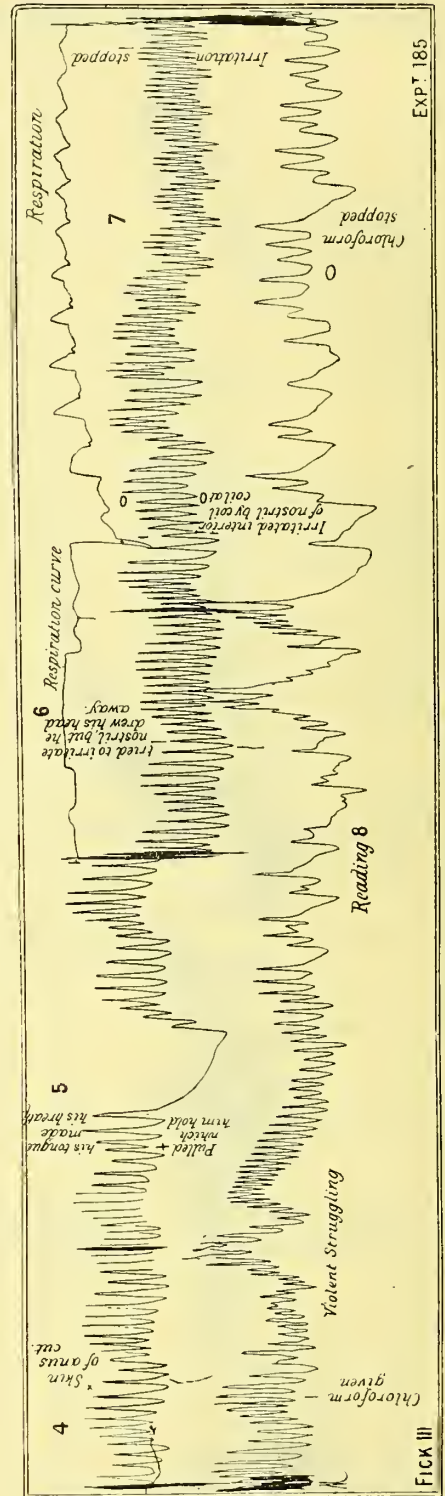
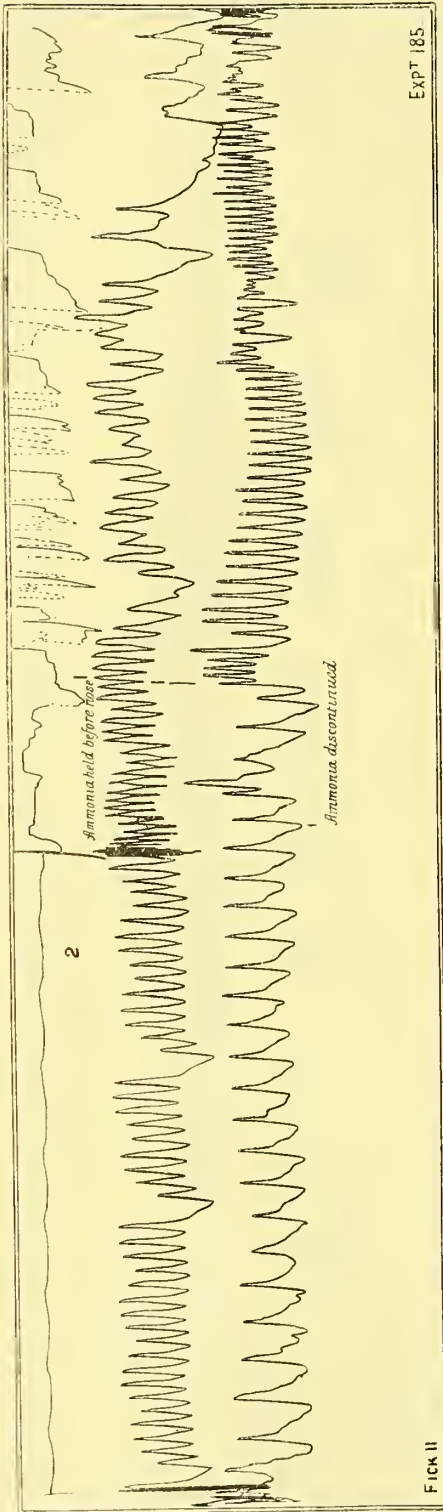
DECEMBER 16TH.—EXPERIMENT 185.



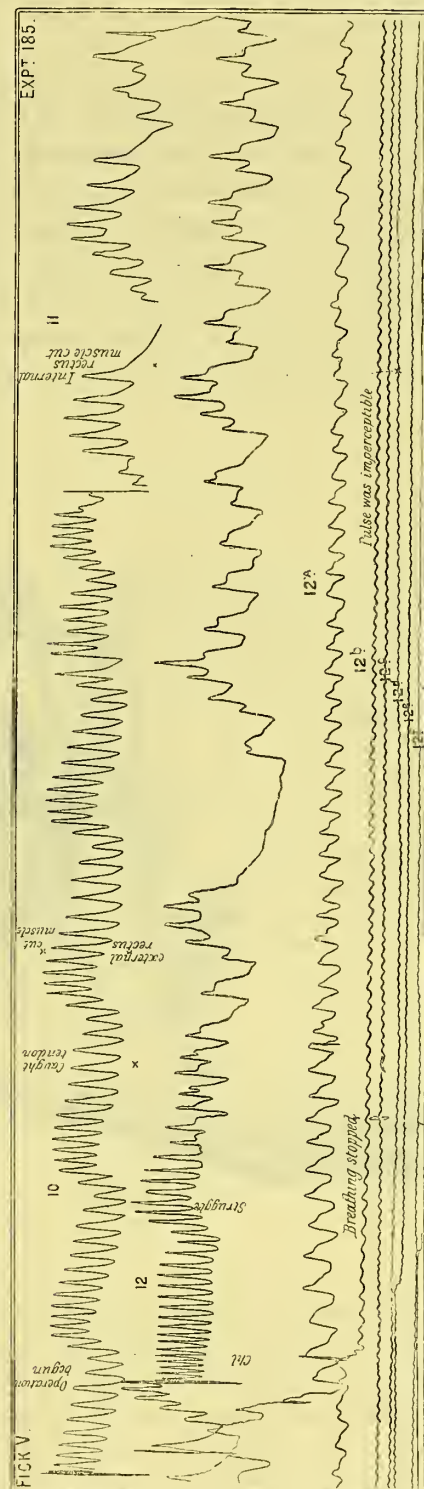
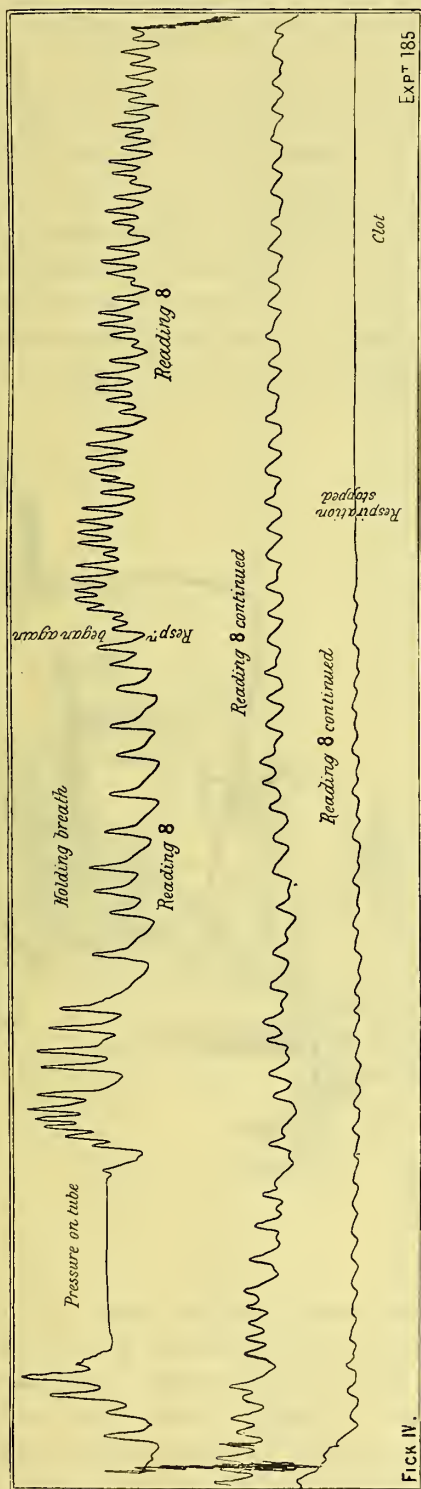
EXPERIMENT 185 (continued).



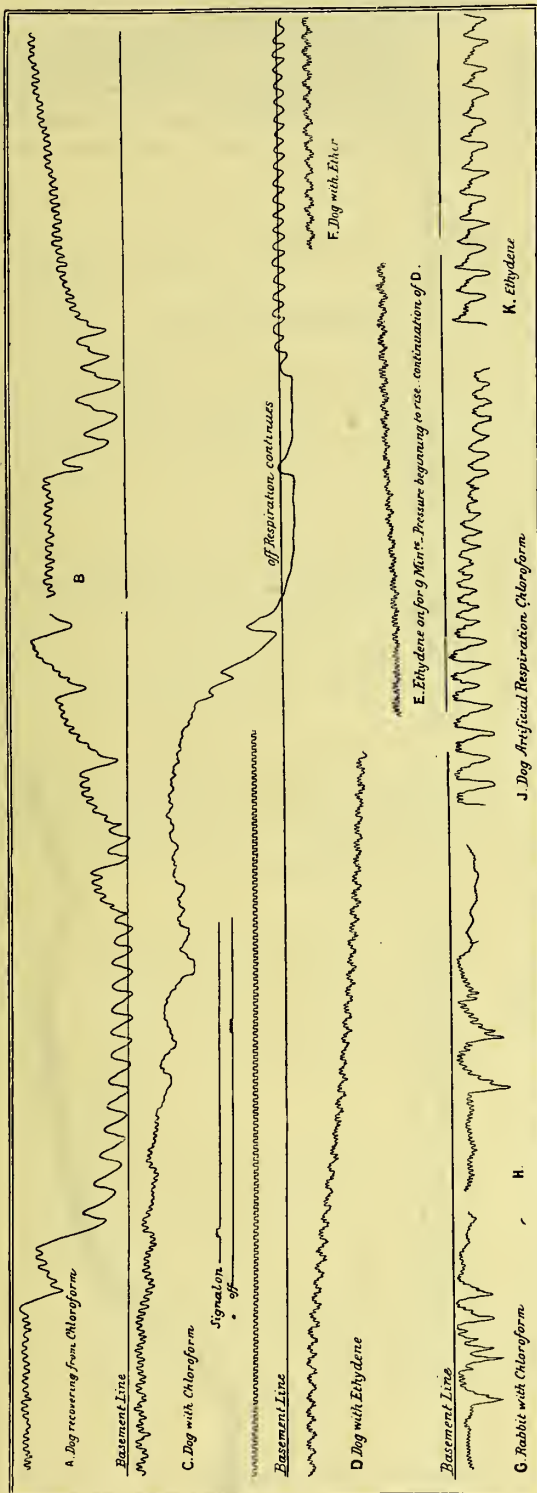
EXPERIMENT 185 (continued).



EXPERIMENT 185 (continued).



THE GLASGOW COMMITTEE'S TRACING, 1879.



The chloroform tracings of the Glasgow experiments should be compared with the Fick tracings of the Commission's Experiments 148, 156, and 185, in which there are irregularities due to asphyxia, or to some interference with or irregularity of the respiration. The Commission has shown that regularity of the respiration ensures regularity of the fall of the blood-pressure in chloroform inhalation, and the fact that the blood-pressure was irregular in the Glasgow Committee's tracings is proof positive that there was irregularity of the respiration of their experiments.

EXPERIMENTS WITH CHLOROFORM MADE BY SURGEON-MAJOR LAWRIE, SURGEON ARTHUR CHAMARETTE, MR. WILLIAM MAYBERRY, AND MR. KNIGHTLEY OWEN BURNE.

Temperature of room 28° C. Chloroform given in box 1 h. 58 m. 30 s. Dog fallen down 2 h. 4 m. Dog on table 2 h. 5 m. Artery ligatured 2 h. 10 m. 30 s. Cannula inserted 2 h. 12 m. 30 s. Connexion with mado-meter made 2 h. 16 m. 30 s.

Ludwig III. shows the effects of—

(a) Recovery from chloroform.

(b) Ordinary chloroform inhalation at 2 h. 53 m. 32 s.

1. Cornea insensitive; dog fully under at 2 h. 54 m. 30 s. 2. Breathing stopped at 2 h. 56 m. 3. Electrical irritation of right vagus coil 5 from 2 h. 56 m. 3 s. to 2 h. 57 m. 25 s. 4. Breathing re-

stored spontaneously; chloroform continued for 30 seconds longer.

(c) Spontaneous recovery without artificial respiration.

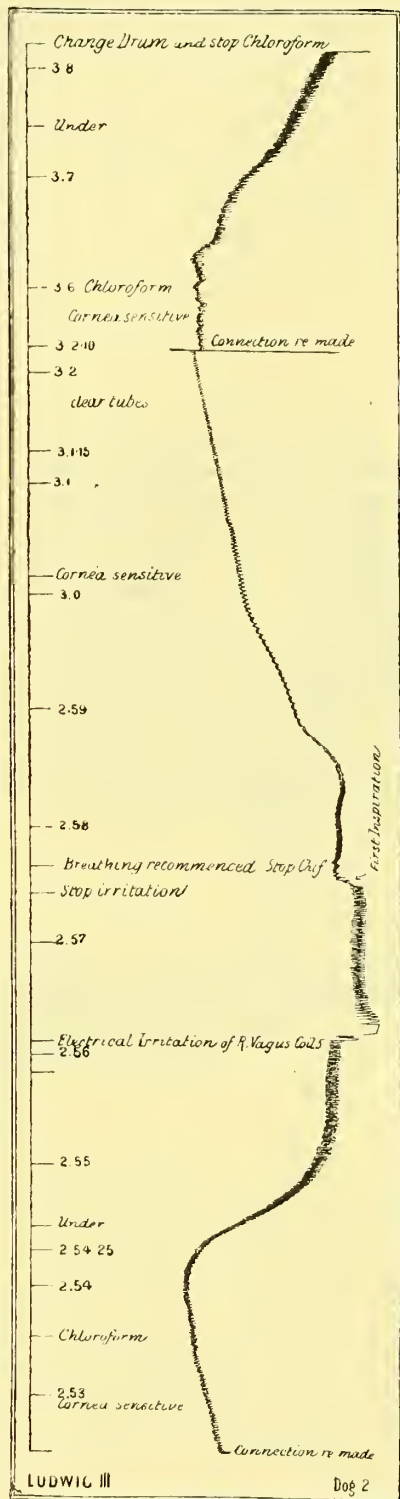
(d) Ordinary chloroform inhalation.

Ludwig IV. shows the effects of—

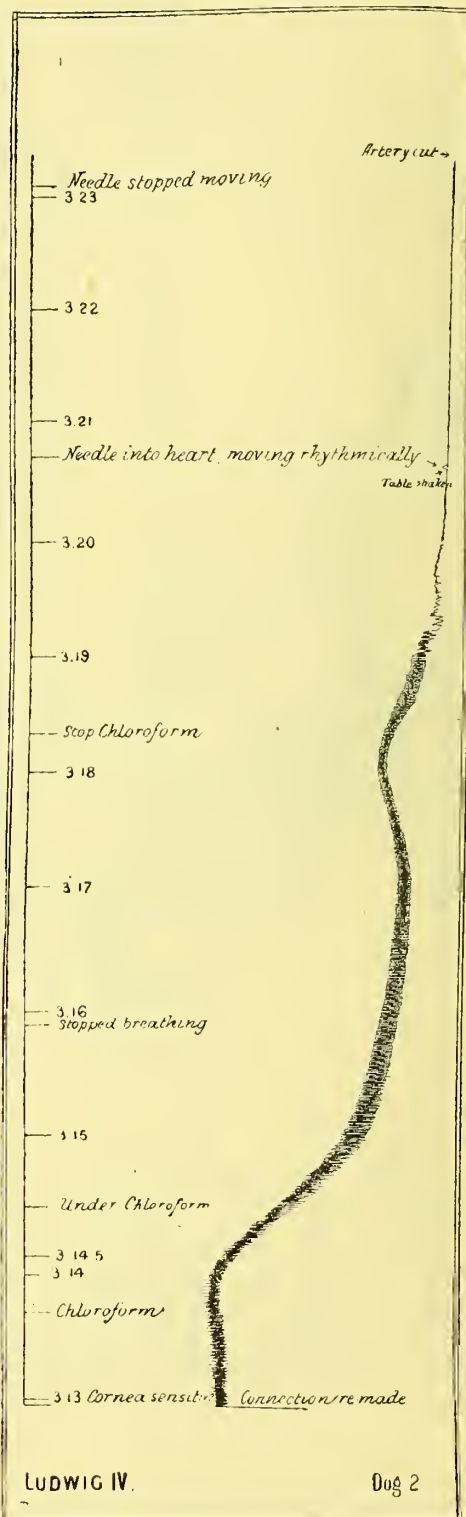
(a) Ordinary chloroform inhalation at 3 h. 13 m. 40 s.

1. Cornea insensitive; dog fully under at 3 h. 13 m. 30 s. 2. Stopped breathing 3 h. 15 m. 50 s. 3. Chloroform cap removed 3 h. 18 m. 15 s. 4. Needle into heart at 3 h. 20 m. 45 s., moving rhythmically until— 5. Heart needle gradually ceased to move at 3 h. 23 m. 5 s. Death

I. EXPERIMENT PERFORMED ON MARCH 6TH, 1890.



II. EXPERIMENT PERFORMED ON MARCH 6TH, 1890.



PRACTICAL CONCLUSIONS.

The following are the practical conclusions which the Commission think may fairly be deduced from the experiments recorded in this report:—

I. The recumbent position on the back and absolute freedom of respiration are essential.

II. If during an operation the recumbent position on the back cannot, from any cause, be maintained during chloroform administration, the utmost attention to the respiration is necessary to prevent asphyxia or an overdose. If there is any doubt whatever about the state of respiration, the patient should be at once restored to the recumbent position on the back.

III. To ensure absolute freedom of respiration, tight clothing of every kind, either on the neck, chest, or abdomen, is to be strictly avoided; and no assistants or bystanders should be allowed to exert pressure on any part of the patient's thorax or abdomen, even though the patient be struggling violently. If struggling does occur, it is always possible to hold the patient down by pressure on the shoulders, pelvis, or legs without doing anything which can by any possibility interfere with the free movements of respiration.

IV. An apparatus is not essential, and ought not to be used, as, being made to fit the face, it must tend to produce a certain amount of asphyxia. Moreover, it is apt to take up part of the attention which is required elsewhere. In short, no matter how it is made, it introduces an element of danger into the administration. A convenient form of inhaler is an open cone or cap with a little absorbent cotton inside at the apex.

V. At the commencement of inhalation care should be taken, not by holding the cap too close over the mouth and nose, to avoid exciting, struggling, or holding the breath. If struggling or holding the breath do occur, great care is necessary to avoid an over-dose during the deep inspirations which follow. When quiet breathing is ensured as the patient begins to go over, there is no reason why the inhaler should not be applied close to the face; and all that is then necessary is to watch the cornea and to see that the respiration is not interfered with.

VI. In children, crying ensures free admission of chloroform into the lungs; but as struggling and holding the breath can hardly be avoided, and one or two whiffs of chloroform may be sufficient to produce complete insensibility, they should always be allowed to inhale a little fresh air during the first deep inspirations which follow. In any struggling persons, but especially in children, it is essential to remove the inhaler after the first or second deep inspiration, as enough chloroform may have been inhaled to produce deep anaesthesia, and this may only appear, or may deepen, after the chloroform is stopped (*vide supra* sub-paragraphs 2 and 9 of conclusions in paragraph 30). Struggling is best avoided in adults by making them blow out hard after each inspiration during the inhalation.

VII. The patient is, as a rule, anaesthetised and ready for the operation to be commenced when unconscious winking is no longer produced by touching the surface of the eye with the tip of the finger. The anaesthetic should never under any circumstances be pushed till the respiration stops; but when once the cornea is insensitive, the patient should be kept gently under by occasional inhalations, and

not be allowed to come out and renew the stage of struggling and resistance.

VIII. As a rule, no operation should be commenced until the patient is fully under the influence of the anaesthetic, so as to avoid all chance of death from surgical shock or fright.

IX. The administrator should be guided as to the effect entirely by the respiration. His only object, while producing anaesthesia, is to see that the respiration is not interfered with.

X. If possible, the patient's chest and abdomen should be exposed during chloroform inhalation, so that the respiratory movements can be seen by the administrator. If anything interferes with the respiration in any way, however slightly, even if this occurs at the very commencement of the administration, if breath is held, or if there is stertor, the inhalation should be stopped until the breathing is natural again. This may sometimes create delay and inconvenience with inexperienced administrators, but experience will make any administrator so familiar with the respirators functions under chloroform that he will in a short time know almost by intuition whether anything is going wrong, and be able to put it right without delay before any danger arises.

XI. If the breathing becomes embarrassed, the lower jaw should be pulled, or pushed from behind the angles, forward, so that the lower teeth protrude in front of the upper. This raises the epiglottis and frees the larynx. At the same time it is well to assist the respiration artificially until the embarrassment passes off.

XII. If by any accident the respiration stops, artificial respiration should be commenced at once, while an assistant lowers the head and draws forward the tongue with catch-forceps, by Howard's method, assisted by compression and relaxation of the thoracic walls. Artificial respiration should be continued until there is no doubt whatever that natural respiration is completely re-established.

XIII. A small dose of morphia may be injected subcutaneously before chloroform inhalation, as it helps to keep the patient in a state of anaesthesia in prolonged operations. There is nothing to show that atropine does any good in connexion with the administration of chloroform, and it may do a very great deal of harm.

XIV. Alcohol may be given with advantage before operations under chloroform, provided it does not cause excitement, and merely has the effect of giving a patient confidence and steadying the circulation.

The Commission has no doubt whatever that, if the above rules be followed, chloroform may be given in any case requiring an operation with perfect ease and absolute safety so as to do good without the risk of evil.

EDWARD LAWRIE (President),
T. LAUDER BRUNTON, } Members.
G. BOMFORD,
RUSTOMJI D. HAKIM, }
EDWARD LAWRIE, Surgeon-Major.

Hyderabad, December 18th, 1889.

(True copy.)

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[APPENDIX.]

THE REPORT OF THE FIRST HYDERABAD CHLOROFORM COMMISSION.

At the recommendation of Surgeon-Major E. Lawrie, M.B., Indian Medical Service, Residency Surgeon, and Principal of the Hyderabad Medical School, his Highness the Nizam's Government appointed a Commission, consisting of a President and two members, to make a series of investigations in connexion with the effects of chloroform on dogs.

The following report by the Commission embodies the results of the experiments undertaken.

The experiments were commenced on Feb. 8th, 1888, and conducted from 11 A.M. to 3 P.M. daily in the verandah of the private ward of the Residency Hospital.

In this report the Commission have incorporated in detail the experiments performed upon 141 dogs with chloroform vapour by inhalation. This number, however, does not embrace all the experiments carried out, for many dogs were anæsthetised twice, and a few three or more times.

The Commission were not influenced in their investigations by experiments carried out previously by other observers.

It was decided to ascertain the influence of chloroform vapour on the circulation and respiration, and inquiries were mainly directed to the discovery of the exact relationship that exists in the dog, in point of time between the cessation of the respiration and of the heart's action.

A further object was to find out to what extent the heart is affected, primarily or secondarily, in poisoning by the inhalation of chloroform vapour. The Commission consider that the data collected definitely settle these questions. In no experiments hitherto performed, as far as can be ascertained from such English medical journals, reports, and text-books as are accessible, has the relation of the respiration to circulation during chloroform anæsthesia of animals been specially attended to, although the influence of the former on the latter is casually mentioned in several reports and medical periodicals.

The experiments were divided into the following four series, in which the dogs were :—

(I.) Anæsthetised until death took place—eight experiments recorded ;

(II.) Chloroformed with large doses of the drug, and the effects of artificial respiration noted—in this series seventy-five experiments are recorded ;

(III.) Gradually anæsthetised with drachm doses of chloroform, with and without artificial respiration—seventeen experiments recorded ; and

(IV.) Poisoned rapidly with large doses of concentrated chloroform vapour as far as possible without admixture with air—forty-one experiments recorded.

In each series the time of the occurrence of the following events were noted : (*a*) commencement of the inhalation ; (*b*) when fully under chloroform ; (*c*) when respiration ceased ; (*d*) when the pulse stopped ; (*e*) when artificial respiration

was begun ; (*f*) when the pulse returned ; (*g*) when natural respiration was re-established ; and (*h*) when the heart's action ceased.

Of the three observers, one confined his attention to the condition of the femoral artery, the second observed the state of the heart's action, and the third watched the respiration and recorded the time. If any doubt existed as to the condition of the pulse, heart, or respiration at any particular moment, a single opinion was not relied on.

Of the 141 animals experimented on, 113 were strong, full-grown, healthy pariah dogs and sluts ; 25 were well-grown, pariah pups about eight months old ; and 3 were healthy mongrel terriers.

The weight and size of the dog did not give rise to any noteworthy peculiarities during the administration of chloroform except such as might have been naturally expected ; the larger and more powerful the dog, the more pronounced the struggling during the initial stage of the administration ; the smaller the dog, the smaller the quantity of chloroform required to produce anæsthesia. The approximate similarity of results indicates that the weight of the animal is not an element that demands any special consideration.

The chloroform was administered from a conical cap made of two folds of coarse cotton cloth (*dungaree*), at the bottom of which some cotton-wool was placed. Free admixture of the chloroform vapour with air was allowed in all but those cases in which it was purposely excluded (fourth series), and to effect this latter purpose a layer of mackintosh was tightly stretched outside the inhaler, which was fixed as to exclude the air almost entirely.

About half the dogs had been deprived of food for twenty-four hours before being experimented on. The condition of the stomach as to fulness or otherwise was apparently of no consequence, for in no case did actual vomiting ensue, although attempts at retching were made in several instances.

Before commencing the administration of the anæsthetic, the animals were muzzled and their fore and hind legs secured to the table. After the first stage of the anæsthesia was induced, directly they got quiet, the muzzle and leg band were removed, so that there was nothing to interfere with the movements of respiration or the circulation.

The animal was considered to be completely under chloroform when, with the cessation of the conjunctival reflex, the general muscular system was relaxed. A very small quantity of chloroform, and that at intervals, was then needed to keep up the anæsthetic effect.

The purity of the chloroform was guaranteed by using that made by Messrs. Duncan and Floekart, of Edinburgh.

We have considered it better to place the groups of experiments separately than to give them collectively ; and to make such remarks on them *seriatim* as the facts connected with each appear to warrant. We give the actual tables in the form of appendices, but attach to each series an abstract showing the mean, maximum, and minimum of time that elapsed between the different events noted.

FIRST SERIES.

DOGS CHLOROFORMISED TILL DEATH.

This collection of experiments (p. 83) was undertaken with the view to ascertain the natural sequence of phenomena in the dog poisoned by chloroform vapour.

The facts registered showed us what was to be expected in the succeeding series. This group might have been extended, but the comparative uniformity of the results made it unnecessary.

The drug was given the same way as it is administered to patients at the Residency and Afzul Gunj Hospitals—i.e., an unmeasured quantity of chloroform was poured into the cloth inhaler, and free admixture with air allowed during inhalation. In this group we pushed the chloroform beyond the stage of complete anaesthesia, and stopped the administration only when respiration had entirely ceased.

The sequence of events was then noted.

The interval of time that elapsed between the different incidents registered in the first series is as follows :—

No.	Nature of observation.	Interval of time.					
		Mean.		Maximum.		Minimum.	
		Min.	Sec.	Min.	Sec.	Min.	Sec.
1	Between cessation of respiration and stoppage of heart's action ...	3	27.5	5.0	...	1	15.0
2	Between cessation of respiration and stoppage of pulse ...	1	31.3	3	30.0	...	100
3	Between stoppage of pulse and that of heart's action ...	1	56.1	3	13.0	...	50.0
4	Between commencement of inhalation and cessation of respiration ...	7	6.1	16	30.0	1	5.0

These events are in what is considered to be the order of their practical importance. The average interval of time between the cessation of the respiration and that of the heart's action is, however, by far the most significant, and amounted to nearly three minutes and a half.

It was found that each animal passed through three stages : 1. A stage of excitement during which there was a temporary exaltation of the functions of the cerebrum and of the circulation; in powerful animals there was much struggling, and in all the blood pressure was raised. 2. These phenomena were followed by a partial relaxation of the voluntary muscular system, and a gradual lowering of the force and decrease in the volume of the pulse. The respirations were now more regular and tranquil. 3. This passed rapidly into the third stage, in which there were cessation of reflex action, of complete muscular relaxation, and complete anaesthesia.

The effects of chloroform vapour on the dog appear to be, primarily, those of a stimulant on the cortical part of the cerebrum, bringing about a discharge of motor impulses represented by struggling—partly voluntary and partly involuntary. As the blood becomes more charged with the vapour an impairment of voluntary muscular power takes place; the functions of the cells of the motor centres are then materially impaired. At this stage reflex action is still possible, for the spinal cord has not been to a similar degree affected by the chloroform. The cord is eventually involved, and then the only remaining manifestations of vitality are the action of the heart and of the respiratory muscles.

It was exceedingly interesting to observe the variations in the characters of the pulse and heart's action during the several stages of chloroform administration.

In the pulse there was primarily a slight and temporary increase in frequency and volume immediately after commencing the inhalation, followed by a decrease in volume and in blood pressure, but no alteration in frequency. In the stage of complete anaesthesia the arteries relaxed, and the number of beats decreased. In the second group of experiments (those of slow poisoning) the pulse in some cases became intermittent shortly after the cessation of respiration, and in the fourth series (rapid poisoning with exclusion of air), the pulse in several cases returned for a few beats after being absent for some seconds.

Although a gradual loss of tension in the arteries took place after the first stage, the ratio decrease of tension was more abrupt when the respiration became affected,

the slowing of the respiration was always succeeded by a sudden increase in the relaxation in the coats of the femoral artery and a fall of tension.

With regard to the heart's action it was observed that a transient stimulation of its force and increase of its frequency during the stage of excitement were speedily succeeded by a gradual decrease of the force of the systolic contraction of the ventricles. The first sound now appeared prolonged (as if the ventricles took a longer period to contract), and after the cessation of the respiration it soon became muffled. The intervals between the beats became longer. This was the moment chosen, as a rule, for artificial respiration in the three succeeding groups of experiments.

In this series, just as the heart was about to cease acting its frequency would become markedly increased (so rapid, indeed, as to be uncountable), and then it would cease contracting. In a number of the second collection of experiments intermission of the heart's action took place after cessation of respiration.

These were the main features observed in connexion with the circulatory apparatus. Others of minor importance were exceptionally manifested.

In some of the eight cases of this group, and in many of those in the following series, so rapidly was the anaesthesia induced that the second stage was absent entirely, the animal appearing to pass directly from struggling to complete anaesthesia.

In these eight cases, and in most of those of the other groups, we noticed complete dilatation of the pupils during the last stages of anaesthesia. This total mydriasis is an indication of approaching cessation of respiration, and consequently may be a point deserving of some attention during the chloroforming of dogs.

Roughly, we found the succession of phenomena to be (1) partial loss of sensation with slightly increased reflex irritability, followed by (2) complete loss of sensation and of reflex action; (3) cessation of respiration; (4) absence of pulse of femoral artery; and finally (5) stoppage of heart's action.

Although the intervals of time between the occurrence of these events varied within wide limits in different cases, in no instance was the sequence modified.

The heart's action never became dangerously affected or stopped until after cessation of respiration.

SECOND SERIES.

ARTIFICIAL RESPIRATION AFTER ARREST OF COMPLETE ANAESTHESIA.

In this collection of experiments (p. 83) anaesthesia was brought about by large doses of chloroform. Artificial respiration was tried in various stages of the anaesthesia, and in addition to the events given in the preceding class of experiments, the length of time it took to produce insensibility was noted.

The intervals of time that elapsed between the several events are as follows :—

No.	Nature of observation.	Interval of time.					
		Mean.		Maximum.		Minimum.	
		Min.	Sec.	Min.	Sec.	Min.	Sec.
1	Between the commencement of the inhalation and the stage of complete anaesthesia.	2	5.5	8	...	...	40.0
2	Between stoppage of respiration and pulse.	...	47.90	6	15.0	...	5.0
3	Between stage of complete anaesthesia and cessation of respiration.	4	45.3	13	10	...	20.0
4	Between stoppage of pulse and heart.	3	0.5	13	26	...	13
5	Between cessation of respiration and stoppage of heart's action.	3	47.5	13	40.0	...	45.0
6	Between cessation of respiration and commencement of artificial respiration.	1	34.25	9	40	...	5
7	Between commencement of artificial respiration and return of pulse.	2	12.3	6	10.0	...	10.0

In the above abstract the points deserving of special attention appear to be :—

(1) The rapidity with which dogs are completely anaes-

thetised with chloroform—an average of a little more than two minutes.

(2) The fact that the pulse went on beating for about three-quarters of a minute after the respiration ceased, and in one case for $6\frac{1}{4}$ minutes.

(3) That the heart went on beating for three (and in one case for $13\frac{3}{4}$) minutes after the pulse had ceased to be felt.

(4) That the heart continued to act for $3\frac{1}{4}$ (and in one case for $13\frac{3}{4}$) minutes after the breathing had stopped.

(5) The average time allowed to clapse before commencing artificial respiration (after the breathing had ceased) was about a minute and a half.

In thirty-seven experiments of this group artificial respiration was commenced on an average fifty-two seconds after complete cessation of respiration. All the animals were resuscitated.

In forty-six experiments artificial respiration was begun immediately after the pulse could no longer be felt; in twenty-nine it was successful; in seventeen it failed.

In twenty-one cases artificial respiration was commenced after the heart's action had ceased; in all it proved unsuccessful.

It is generally recognised and taught that in the chloroforming of human beings the greatest danger arises during the initial stage from either cardiac syncope, due to the drug acting on the inter-cardiac nervous ganglia, from reflex inhibition of the heart's action brought about by irritation of the terminations of the sensory or afferent nerves in some part of the respiratory passages, or from "shock" during the performance of some operation. The Commission have endeavoured to ascertain how far these views could be substantiated in the chloroform anæsthesia of dogs.

The following are the deductions made :—

(1) In no case did arrest of cardiac action from syncope take place during the first stage—nor indeed in any other stage.

(2) In no case was there reflex inhibition of the heart's action in this or in any other stage.

(3) The inhalation of chloroform vapour, no matter in what doses or in what manner carried out, cannot kill a dog by acting directly upon its heart. We must invariably affect the nervous mechanism of respiration before involving the cardiac centres of the medulla oblongata or affecting the contractions of the ventricles and auricles to any extent.

(4) The Commission further consider that chloroform vapour administered to dogs never kills by acting on the intra-cardiac ganglia either primarily or secondary. It is impossible to produce syncope from chloroform in dogs.

One noteworthy fact observed in this series is that in those cases in which the respiratory process was gradually extinguished the pulse became imperceptible with unusual rapidity after the breathing ceased, and in such cases it required more prolonged artificial respiration to revive the animal. This contrasts with what was found to be the case with the dogs of the fourth series, in which it was found that the larger the dose of the chloroform administered, the more rapidly is the anæsthesia produced; the longer the pulse was felt to beat after cessation of respiration, and the less the difficulty in re-establishing the respiration by artificial means.

In some instances, so gradual was the cessation of the action of the respiratory muscles that it was not easy to distinguish the precise moment at which respiration stopped.

In this group of experiments the influence of the respiratory process on the circulation became markedly apparent when the former ceased. The failure in the volume of the pulse in the later stages of slow poisoning was almost in exact proportion to the failure of the respiratory function.

The Commission are of opinion that in the dog the danger to life from chloroform inhalation arises only when the cells of the respiratory centres (both respiratory and expiratory) of the medulla oblongata have their functions interfered with.

So long as respiration is going on uninterruptedly the chloroform vapour is rapidly given off in the expired air. Disturbance of this eliminative process, as manifested by shallow, jerky, or irregular breathing, forms the only

dangerous phenomenon to be encountered in the chloroformisation of dogs.

The main practical point brought out by this series of experiments is that the strictest attention must be paid to the respiration throughout. So long as the respiration was watched and advantage taken of the moment it ceased to perform artificial respiration no danger arose. Further, alternate chloroformisation till the complete stoppage of respiration and re-establishment of respiration by artificial means might have been repeated on the same animal as often as we wished without the least risk to life.

The manner in which the animals respired during the inhalation affected, to some degree, the rapidity of the onset of the anæsthesia. This is well shown in the difference in the length of time it took to get some of the dogs (in all physical conditions identical) completely under the influence of the drug.

It was observed that irregular sighing, or shallow respiration, was in this series an indication for removal of the inhaler.

Stertor is not an indication of incipient respiratory difficulty in dogs.

Mechanical asphyxia from falling back of the tongue occurred in several cases during complete anæsthesia. It was readily remedied by opening the dog's mouth widely and drawing out the tongue.

In a number of cases there was frothing at the mouth.

In many of these experiments it was noticed that the return to consciousness was extremely rapid. Some dogs became sensible within two minutes.

This appears to indicate a speedy elimination of the drug. In most cases in which return to consciousness was permitted, the period of somnolence was very brief. It may be inferred from this that no great structural, metabolic, or chemical change can occur in the protoplasm of the grey cells of the central cortex during the anæsthesia. Probably no material, or at least appreciable, alteration does occur. The effects of chloroform appear to be such as would bring about a temporary abrogation of the physiological functions of the cells of the higher nerve centres.

During the stage of excitement in many cases there was relaxation of the sphincters of the bladder and anus, resulting in micturition and defecation. More rarely there was erection of the penis and seminal discharge.

Towards the end of the stage of struggling, in several instances we noticed that chronic spasms occurred in the extremities. They were very evanescent.

When any animal rigidity of the abdominal muscles appeared (this phenomenon being almost exclusively confined to the first stage) a few sharp slaps with the open hand was sufficient to re-excite respiration. It was further observed that struggling demanded that the chloroform be pushed and not withheld.

THIRD SERIES.

DOGS GRADUALLY ANÆSTHETISED WITH CHLOROFORM.

In the seventeen cases (p. 85) recorded in this group the anæsthetic was used in drachm doses. As will be seen from the figures given below, it took longer to render the animals insensible with those smaller doses. The average maxima and minima of time that lapsed between the several events that were registered are as follows:—

No.	Nature of observation.	Interval of time.					
		Mean.		Maximum.		Minimum.	
		Min.	Sec.	Min.	Sec.	Min.	Sec.
1	Between the commencement of inhalation and complete anæsthesia ...	2	34.25	5	10.0	...	37.0
2	Between complete anæsthesia and stoppage of respiration ...	6	59.12	13	27.0	1	5
3	Between cessation of respiration and stoppage of pulse ...	...	47.5	3	21.0	...	8.0
4	Between stoppage of pulse and beating of heart ...	2	16.5	4	48	...	35

These results are, on the whole, identical with those given in the preceding groups of experiments. The only noteworthy difference is in the rapidity with which the heart ceases to beat in very slow chloroformisation (two

minutes and a quarter) as compared with anaesthesia more rapidly induced.

Artificial respiration was tried in five of these experiments when the heart's sounds were barely audible, and had almost stopped. In one case the animal revived.

In this series when the breathing had become shallow and less frequent a few whiffs of the chloroform were sufficient to cause its entire cessation.

FOURTH SERIES.

DOGS RAPIDLY ANÆSTHETISED WITH CHLOROFORM VAPOUR WITHOUT ADMIXTURE WITH AIR.

In the 41 cases enumerated in Appendix IV. (p. 86) the animals were poisoned with large doses of chloroform, while special precautions were taken to prevent admixture of the vapour with air.

The intervals of time between the different events noted were as under;—

No.	Nature of observation.	Interval of time.					
		Mean.		Maximum.		Minimum.	
		Min.	Sec.	Min.	Sec.	Min.	Sec.
1	Between commencement of inhalation and complete anaesthesia ...	1	15.8	2	57	...	26
2	Between complete anaesthesia and cessation of respiration ...	2	11.33	9	28	...	10
3	Between stoppage of respiration and pulse ...	1	0.6	7	52	...	5
4	Between stoppage of pulse and heart's action... ..	2	33.6	7	1	...	53

The points deserving of notice here are:—(1) the rapidity with which anaesthesia is produced with large doses of chloroform, the average time being one minute and a quarter, and (2) the fact that the cardiac action is less hampered than in anaesthesia produced gradually.

Artificial respiration was tried in one of these cases, and proved successful, when the pulse had ceased for twenty-eight seconds.

In sixteen cases, before the inhalation was begun, one drachm to two drachms of rum were administered. The stimulant produced no appreciable result.

In three cases after respiration had ceased, faradic electricity was used to re-establish respiration. It proved successful in all.

The experiments recorded lead the Commission to consider that dogs are very susceptible to anaesthesia by chloroform vapour. Insensibility is rapidly induced, and these animals are easily killed by chloroform. The sus-

ceptibility varied somewhat with the size of the animal. In strong and healthy dogs, however, the results were comparatively uniform, although the differences between the maxima and minima of certain events might lead to the opposite conclusion.

The main point in the chloroforming of dogs is to watch the breathing. In all cases where artificial respiration was begun immediately the natural respiration ceased the animal recovered.

Artificial respiration is useless in the vast majority of cases if respiration has ceased for more than fifty seconds, and even after fifty seconds it is not invariably successful.

The animals could be revived in almost every case if not more than thirty seconds had elapsed after cessation of natural breathing.

In no case was artificial respiration of use after the heart had ceased to beat, and in only one case was it successful when the heart's sounds were barely audible.

Rapid induction of anaesthesia is succeeded by rapid elimination of the chloroform.

There is very little tendency to a cumulative effect of the chloroform as long as the process of respiration is not interfered with. Such an effect is, however, distinctly marked when the quantity of air leaving the lungs is materially decreased.

The more concentrated the vapour the more rapid the anaesthesia, and (unless an over-dose be given, which would interfere with the functions of the respiratory centre, and therefore with the elimination of the chloroform) the more rapidly is the return to consciousness re-established. In no case did the heart cease acting before the respiratory muscles. In no case during the anaesthesia did the irritation of the vapour on the terminal fibres of the afferent nerves of the nasal, pharyngeal, laryngeal, or pulmonary mucous surfaces or impulses from any other afferent nerves produce anything simulating reflex inhibition of the heart's action.

In no case did cardiac syncope occur. The Commission consider that it is impossible for chloroform vapour to kill a dog by acting primarily on the heart, and this holds good no matter in what doses or in what manner the poisoning is induced.

It is the opinion of the Commission that death from chloroform narcosis in dogs is absolutely avoidable, and ought never to occur from surcharging of the blood with chloroform. Once anaesthesia is induced, so long as the respiration is kept up, there is no fear of a cumulative effect—the drug is rapidly eliminated. Interference with this elimination brings about changes in the respiratory mechanism which ought to arouse suspicion and prepare us for artificial respiration.

For convenience of reference we give the subjoined table of the intervals of time that elapsed between the principal events noted:—

Combined Table of Intervals of Time between the different events registered in all four Series.

Number.	Nature of observation.	Intervals of time.																	
		1st Series. CHCl ₃ administered in ordinary way.						2nd Series. Slow poisoning.						3rd Series. Slow poisoning with drachm doses.					
		Mean.		Maxi- mum.		Mini- mum.		Mean.		Maxi- mum.		Mini- mum.		Mean.		Maxi- mum.		Mini- mum.	
		M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.
1	Between the commence- ment of the inhalation and the stage of com- plete anaesthesia ... ..	...	...	...	...	...	...	2	55	8	...	40.0	2	34.25	5	10.0	...	37.0	1
2	Between stoppage of re- spiration and of pulse...	1	31.3	3	30.0	...	10.0	...	47.9	6	15	...	5.0	...	47.5	3	21.0	...	8.0
3	Between stage of com- plete anaesthesia and cessation of respiration.	...	...	...	...	...	...	4	45.3	13	10.0	...	20.0	6	59.12	13	27.0	1	5.0
4	Between stoppage of pulse and of heart	1	56.1	3	13.0	...	50.0	3	0.5	13	26	...	13	2	16.5	4	48	...	35
5	Between cessation of re- spiration and stoppage of heart's action	3	27.5	5.0	...	1	15.0	3	47.5	13	40.0	...	45.0	...	...	...	...	...	...
6	Between cessation of re- spiration and commence- ment of artificial respi- ration ... ..	...	...	...	...	...	...	1	34	25	9	40	...	5	...	...	...	...	...
7	Between commencement of artificial respiration and return of pulse ... ..	...	...	...	...	...	...	2	12.3	6	10.0	...	10.0	...	...	...	...	...	...
8	Between commencement of inhalation and cessa- tion of respiration... ..	7	6.1	16	30.0	1	5.0	...	...	...	...	...	...	...	...	...	...	...	...

In conclusion, the Commission would state that many other interesting phenomena might have been brought out on these experiments. Additional observations could have been made, but they would have tended to lessen the value of the special investigations in hand. Any supplementary notes taken at the time would have prevented that concentration of attention which the facts herein accumulated demanded. The nature of the data collected attest that the keenest watchfulness was indispensable throughout; the loss of a few seconds in any particular case would

have vitiated the experiment. The Commission would suggest the continuation of the experiments on dogs, but with such modifications as to permit of a more complete comparison between the phenomena of chloroformisation in the dog and in the human being, so that the points of contrast and agreement might be rendered more demonstrable.

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SERIES I.--(3 EXPERIMENTS)

APPENDIX NO. I.--Dogs "chloroformed" till death occurred.

No. of experiment.	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart ceased beating.	Remarks.
1	Full-grown, powerful pariah dog.	H. M. S. 11 30 0	No record taken.	H. M. S. 11 46 30	H. M. S. 11 50 0	Not tried.	...	...	H. M. S. 11 51 30	---
2	Pariah pup, slut, six months old	12 5 0	Do.	12 8 45	12 9 10	Do.	...	...	12 10 0	---
3	Pariah pup, fairly nourished, six months old.	12 20 0	Do.	12 21 5	12 22 5	Do.	...	...	12 25 18	---
4	Full-grown, well-nourished pariah dog.	12 38 0	Do.	12 41 45	12 41 55	Do.	...	...	12 44 17	---
5	Pariah pup, five months old.	12 56 0	Do.	1 0 30	1 3 15	Do.	...	...	1 5 10	---
6	Powerful Binjari dog, full-grown.	1 14 0	Do.	1 24 0	1 24 10	Do.	...	...	1 27 4	---
7	Full-grown terrier slut.	2 27 0	Do.	2 37 6	2 38 45	Do.	...	...	2 40 0	---
8	Full-grown, well-nourished terrier slut.	2 45 0	Do.	2 52 8	2 54 40	Do.	...	...	2 56 10	---

SERIES I.--(75 EXPERIMENTS)

APPENDIX NO. II.--Artificial respiration tried after large doses of chloroform.

No. of experiment.	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart ceased beating.	Remarks.
1	Well-nourished, full-grown pariah dog.	H. M. S. 12 30 0	H. M. S. No record taken.	H. M. S. 12 18 30	H. M. S. 12 19 10	H. M. S. 12 20 0	H. M. S. 12 21 0	H. M. S. 12 21 30	...	Artificial respiration successful fifty seconds after stoppage of pulse.
2	Pariah pup, one year old.	12 45 0	Do.	12 50 0	12 51 10	12 51 10	...	...	12 52 20	Artificial respiration unsuccessful immediately after stoppage of pulse.
3	Well-nourished, powerful Binjari slut.	1 2 0	Do.	1 5 40	1 6 1	1 6 4	...	...	1 16 0	Artificial respiration unsuccessful three seconds after stoppage of pulse.
4	Full-grown pariah dog.	1 23 0	Do.	1 31 30	1 32 0	1 32 2	...	...	1 35 0	Artificial respiration unsuccessful two seconds after stoppage of pulse.
5	Healthy pariah pup, five months old.	2 14 0	Do.	2 30 30	2 30 45	2 30 45	2 32 0	2 35 40	...	Artificial respiration successful immediately on stoppage of pulse.
6	Well-nourished, full-grown pariah dog.	12 17 0	Do.	12 34 40	12 35 40	12 35 40	...	...	12 37 0	Artificial respiration immediately after stoppage of pulse; unsuccessful.
7	Ditto.	12 48 15	12 51 0	12 52 50	12 53 15	12 53 16	12 55 30	12 56 45	...	Artificial respiration one second after stoppage of pulse; successful.
8	Ditto.	1 2 0	1 3 40	1 7 30	1 8 30	1 8 30	1 9 45	1 10 10	...	Artificial respiration after stoppage of pulse; successful.
9	---	1 12 30	No record taken.	1 15 55	1 16 30	1 18 30	...	...	1 18 25	Artificial respiration after stoppage of heart; unsuccessful.
10	Well fed, old pariah dog.	1 33 0	1 41 0	1 45 5	1 45 50	1 45 50	...	...	1 47 8	Artificial respiration after stoppage of pulse; unsuccessful.
11	Full-grown, healthy pariah slut.	2 10 0	2 12 30	2 19 50	2 20 45	2 20 45	2 30 40	2 25 30	...	Artificial respiration after stoppage of pulse; successful.
12	---	2 26 0	No record.	2 34 55	2 35 10	2 37 40	...	...	2 37 35	Artificial respiration after stoppage of heart; unsuccessful.
13	Well-fed, full-grown pariah dog.	2 45 0	2 47 15	2 55 10	2 55 0	2 56 0	2 56 15	2 57 20	...	Artificial respiration after stoppage of pulse; successful.
14	---	2 58 30	No record.	3 4 15	3 5 10	3 7 60	...	...	3 7 60	Artificial respiration after stoppage of heart; unsuccessful.
15	Healthy, full-grown pariah dog.	3 15 0	3 17 30	3 23 30	3 24 10	3 24 10	...	...	3 25 0	Artificial respiration after cessation of pulse; successful.
16	Small-sized pariah dog.	3 38 0	3 40 10	3 48 45	3 49 30	3 49 30	3 53 20	3 54 0	...	Do. do.
17	---	3 55 0	No record.	3 55 40	3 57 0	3 59 10	...	...	3 59 0	Artificial respiration after stoppage of heart; unsuccessful.
18	Well-nourished, full-grown pariah dog.	12 6 0	12 10 45	12 20 0	12 20 45	12 20 45	12 22 10	12 25 30	...	Artificial respiration after stoppage of pulse; successful.
19	---	12 26 30	No record.	12 40 55	12 43 30	12 46 0	...	...	12 45 50	Artificial respiration after stoppage of heart; unsuccessful.
20	Full-grown pariah dog.	12 51 30	12 53 30	1 6 0	1 6 15	1 6 35	1 7 10	1 8 10	...	Artificial respiration after stoppage of pulse; successful.
21	---	1 10 0	No record.	1 16 30	1 16 48	1 19 0	...	...	1 19 0	Artificial respiration after stoppage of heart; unsuccessful.
22	---	1 40 0	1 41 10	1 44 55	1 47 35	1 48 0	1 49 40	1 50 0	...	Artificial respiration after stoppage of pulse; successful.
23	---	1 52 0	No record.	1 53 0	1 53 32	1 53 0	...	...	1 53 45	Artificial respiration after stoppage of heart; unsuccessful.

No. of experiment	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart ceased beating.	Remarks.
24	Healthy, full-grown pariah dog.	H. M. S. 2 19 30	H. M. S. 2 22 10	H. M. S. 2 31 30	H. M. S. 2 32 0	H. M. S. 2 32 10	H. M. S. 2 34 30	H. M. S. 2 35 0	...	Artificial respiration after stoppage of pulse; successful.
25	—	2 37 40	No record.	2 44 20	2 46 20	2 49 40	...	...	2 49 40	Artificial respiration after stoppage of heart; unsuccessful.
26	Full-grown pariah slut.	2 56 57	6 59 0	3 0 30	3 0 45	3 0 48	3 1 20	3 5 20	...	Artificial respiration after cessation of pulse; successful.
27	Well-nourished pariah pup, four months old.	3 14 20	3 15 40	3 21 0	3 22 45	3 22 50	...	...	3 23 30	Artificial respiration after cessation of pulse; unsuccessful.
28	Pariah pup, three months old.	3 31 0	3 32 0	3 35 20	3 36 0	3 37 0	3 37 10	3 40 45	..	Artificial respiration after cessation of pulse; successful.
29	—	3 41 0	No record.	3 46 10	3 46 45	3 50 0	...	...	3 49 55	Artificial respiration after stoppage of heart; unsuccessful.
30	Fairly nourished pariah pup four months old.	12 15 30	12 18 30	12 27 45	12 27 48	12 27 50	12 32 15	12 34 55	...	Artificial respiration after stoppage of pulse; successful.
31	—	12 37 30	No record.	12 40 30	12 40 45	12 43 50	...	...	12 43 45	Artificial respiration after stoppage of heart; unsuccessful.
32	Pariah pup, fairly nourished, four months old.	12 50 0	12 51 15	12 52 45	12 53 0	12 53 6	...	...	12 54 45	Artificial respiration after stoppage of pulse; unsuccessful.
33	Healthy, full-grown pariah slut.	1 8 0	1 11 0	1 14 10	...	1 14 20	...	1 16 10	...	Artificial respiration after stoppage of respiration; successful.
34	—	1 17 0	No record.	1 21 45	No record.	1 23 35	...	...	1 23 30	Artificial respiration after stoppage of heart; unsuccessful.
35	Powerful, full-grown pariah dog.	1 25 0	1 26 20	1 39 30	1 40 30	1 40 35	1 42 10	1 45 50	...	Artificial respiration after stoppage of pulse; successful.
36	—	1 48 30	No record.	1 54 30	2 0 45	2 4 10	...	...	2 4 8	Artificial respiration after stoppage of heart; unsuccessful.
37	Full-grown, powerful pariah dog.	1 4 0	1 5 0	1 5 45	1 5 55	1 6 10	1 10 43	1 13 33	...	Artificial respiration after stoppage of pulse; successful.
38	—	1 14 30	No record.	1 23 12	1 23 18	1 25 45	...	...	1 25 42	Artificial respiration after stoppage of heart; unsuccessful.
39	Full-grown, fairly nourished pariah dog.	1 38 0	1 39 58	1 52 30	1 54 13	1 54 15	...	...	1 58 30	Artificial respiration after stoppage of pulse; unsuccessful.
40	Pariah pup, six months old.	2 36 0	2 38 22	2 41 8	2 41 20	2 41 30	2 44 10	2 45 48	...	Artificial respiration after stoppage of pulse; successful.
41	—	2 47 0	No record.	2 53 43	2 54 10	2 56 10	...	...	2 56 10	Artificial respiration after stoppage of heart; unsuccessful.
42	Pariah pup, eight months old.	3 5 30	3 8 12	3 21 0	...	3 21 5	...	3 23 8	...	Artificial respiration after stoppage of respiration; successful.
43	—	3 24 0	No record.	3 26 12	3 26 18	3 29 0	...	...	3 28 18	Artificial respiration after stoppage of heart; unsuccessful.
44	Full-grown pariah slut, well-nourished	11 40 0	11 42 55	11 46 25	11 47 33	11 47 35	11 48 12	11 50 10	...	Artificial respiration after stoppage of pulse; successful.
45	—	11 53 45	No record.	11 57 18	11 57 25	12 1 10	...	...	12 1 8	Artificial respiration after stoppage of heart; unsuccessful.
46	Powerful, full-grown pariah dog.	12 22 0	12 23 41	12 24 0	12 24 50	12 24 50	12 28 0	12 28 35	...	Artificial respiration after stoppage of pulse; successful.
47	—	12 33 17	12 34 45	12 40 38	12 40 47	12 42 55	12 44 20	...	...	Ditto
48	Pariah slut, full grown.	1 10 30	1 12 0	1 19 15	1 19 40	1 19 50	1 23 25	...	1 25 0	Natural respiration was thought to have been re-established, as the dog breathed for a minute after stoppage of artificial respiration; but the respiration suddenly ceased again, pulse again stopped, and could not be restored. Artificial respiration after stoppage of pulse; unsuccessful.
49	Powerful, full-grown pariah dog.	1 35 0	1 39 45	1 40 10	...	1 40 20	...	1 43 20	...	Artificial respiration after stoppage of respiration; successful.
50	—	1 50 45	1 52 35	2 4 30	2 6 45	2 6 45	2 9 30	2 11 10	...	Artificial respiration after stoppage of pulse; successful.
51	Healthy, full-grown pariah slut.	2 25 0	2 26 8	2 29 7	2 29 30	2 29 45	2 31 25	2 33 55	...	Ditto ditto
52	—	2 37 41	...	2 38 40	2 38 55	...	...	...	...	Artificial respiration after stoppage of heart; no effect.
53	Full-grown, powerful pariah dog.	11 29 0	11 30 48	11 33 20	...	11 33 40	...	11 37 40	...	Artificial respiration after stoppage of respiration; successful.
54	Healthy pariah pup, six months old.	11 41 0	11 42 30	11 54 5	11 54 20	11 54 20	...	...	11 55 10	Artificial respiration after stoppage of pulse; unsuccessful.
55	—	12 4 39	12 5 46	12 7 5	No record.	12 8 45	...	...	12 8 40	Artificial respiration after stoppage of heart; unsuccessful.
56	Strong pup, nearly full grown.	12 16 44	12 18 46	12 19 45	12 20 25	12 20 35	12 26 0 Flicker'd and then stopped entirely.	...	?	Artificial respiration after stoppage of pulse; unsuccessful.
57	Healthy, full-grown slut.	12 39 23	12 41 46	12 43 0	12 43 20	12 43 40	12 44 40	12 45 0	...	Artificial respiration after cessation of pulse; successful.
58	Healthy, full-grown pariah slut.	12 59 0	1 1 15	1 4 25	...	1 4 30	...	1 7 25	...	Artificial respiration after stoppage of respiration; successful.
59	—	1 9 30	1 10 40	1 13 0	1 13 5	1 16 15	...	...	?	Artificial respiration after stoppage of pulse; unsuccessful.
60	Healthy pariah pup, three months old.	1 27 30	1 28 10	1 29 30	1 29 40	1 29 45	...	...	?	Artificial respiration after stoppage of pulse; unsuccessful.
61	Lean, but full-grown pariah dog.	1 47 0	1 49 5	1 54 30	1 55 0	1 55 5	1 55 55	1 59 45	...	Artificial respiration after stoppage of pulse; successful.
62	—	2 2 0	2 3 40	2 12 10	2 13 5	2 15 32	...	...	2 15 30	Artificial respiration after stoppage of heart; unsuccessful.
63	Strong, full-grown pariah slut.	2 25 0	2 27 35	2 30 30	2 31 40	2 31 55	2 32 25	2 34 30	...	Artificial respiration after cessation of pulse; successful.
64	—	2 35 50	2 36 55	2 41 15	2 42 0	2 43 0	2 47 45	2 48 0	...	Artificial respiration commenced on heart being barely audible, stethoscope; successful.

No. of experiment.	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart ceased beating.	Remarks.
65	Powerful, full-grown pariah dog.	H. M. S. 11 35 30	H. M. S. 11 37 10	H. M. S. 11 40 50	H. M. S. 11 41 8	H. M. S. 11 41 15	H. M. S. 11 46 30	H. M. S. 11 47 12	H. M. S. ...	Artificial respiration after stoppage of pulse; successful.
66	—	11 47 30	11 50 0	11 51 15	11 51 30	11 51 45	...	...	11 53 30	Artificial respiration after cessation of pulse; unsuccessful.
67	Strong, full-grown pariah slut.	12 12 30	12 14 25	12 16 10	12 16 38	12 17 0	12 17 45	12 18 53	...	Artificial respiration after stoppage of pulse; successful.
68	Powerful, full-grown pariah dog.	12 23 0	12 25 5	12 29 0	12 29 45	12 30 8	12 31 5	12 32 40	...	Ditto
69	—	12 46 30	12 49 6	12 50 10	12 50 24	12 51 0	...	A few spasmodic contractions of abdominal muscles	1 3 50	Artificial respiration after pulse stopped; unsuccessful.
70	Healthy, full-grown pariah dog.	1 11 15	1 13 7	1 18 55	1 19 10	1 19 45	1 35 55	1 38 20	...	Artificial respiration after pulse stopped; successful. Extraordinary case. Hot water thrown over chest.
71	Healthy, full-grown pariah slut.	1 49 16	1 51 11	1 52 5	1 54 16	1 54 17	1 57 2	1 58 5	...	Artificial respiration after pulse stopped; successful.
72	—	2 0 45	2 1 50	2 3 30	2 4 0	Artificial respiration not tried.	...	...	2 8 5	—
73	Full-grown, powerful pariah dog.	2 37 20	2 38 25	2 40 15	2 40 38	2 42 17	...	...	No record; died.	Artificial respiration after pulse stopped; no effect.
74	Full-grown, healthy pariah dog.	2 50 10	2 51 45	2 52 50	2 54 56	2 54 25	2 55 40	2 55 50	...	Artificial respiration after cessation of respiration; successful.
75	—	2 58 0	5 59 40	3 6 0	3 6 30	Artificial respiration not tried.	...	...	3 8 30	—

SERIES III.—(17 EXPERIMENTS.)

APPENDIX NO. III.—Dogs chloroformed very gradually with 2-dr. doses

No. of experiment.	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart stopped.	Remarks.
1	Full-grown, healthy pariah dog.	H. M. S. 12 30 0	H. M. S. 12 33 20	H. M. S. 12 48 50	H. M. S. 12 49 20	H. M. S. ...	H. M. S. ...	H. M. S. ...	H. M. S. 12 51 40	½ oz. of CHCl ₃ used.
2	Ditto.	12 53 0	12 53 50	12 55 0	...	...	...	...	...	Spontaneously breathed again after inhalation was stopped and allowed to revive.
3	—	12 57 0	No record.	12 57 40	12 57 50	12 58 45	...	...	12 58 25	Artificial respiration after heart stopped; unsuccessful.
4	Full-grown, healthy pariah dog.	1 8 0	1 11 10	1 17 10	1 17 20	...	...	...	1 19 42	3 drs. of CHCl ₃ used.
5	Strong, full-grown pariah dog.	1 26 45	1 27 30	1 35 38	1 35 48	...	...	...	1 37 45	½ oz. of ditto used.
6	Ditto.	1 51 45	1 53 35	2 7 2	2 7 15	...	...	...	2 9 40	3 drs. of ditto used.
7	Strong, healthy pariah slut.	2 19 30	2 24 40	2 33 50	2 34 28	...	...	...	2 36 10	½ oz. of ditto used.
8	Full-grown, large-sized pariah dog.	11 50 30	11 54 22	12 0 43	12 1 0	12 2 0	...	...	12 1 59	2½ drs. of chloroform. Artificial respiration after stoppage of heart; no effect.
9	Ditto.	12 10 6	12 13 57	12 17 50	12 17 58	...	...	...	12 21 35	2½ drs. of chloroform.
10	Ditto.	12 30 5	12 31 50	12 39 39	12 43 0	12 44 0	...	...	12 43 54	3 drs. of chloroform. Artificial respiration after heart stopped; no effect.
11	Powerful, full-grown pariah dog.	1 52 45	1 55 34	1 57 55	1 58 42	...	...	...	1 59 20	3 drs. of chloroform with stethoscope. Artificial respiration commenced when heart's beat about to stop and barely audible.
12	Ditto.	2 7 35	2 8 12	2 12 15	2 12 35	2 13 45	...	...	2 14 10	3 drs. of chloroform used. Artificial respiration; no effect after pulse stopped, and heart barely audible.
13	Lean, full-grown pariah dog.	2 22 30	2 25 0	2 28 55	2 29 10	3 31 45	...	...	2 33 15	3 drs. of chloroform used. Artificial respiration; no effect after pulse stopped, and heart barely audible.
14	Lean pup, eight months old.	11 54 0	11 55 12	12 7 40	12 8 32	12 9 20	Returned at 12-10-50 for a few seconds and stopped entirely.	Gasped thrice.	12 12 25	2½ drs. of chloroform. Artificial respiration; no effect after pulse stopped, and heart barely audible.
15	Powerful, full-grown pariah dog.	12 25 30	12 29 24	12 32 28	12 32 36	12 36 0	12 38 2	12 39 20	...	3 drs. of chloroform. Artificial respiration successful after pulse stopped, and heart barely audible.
16	—	12 42 0	12 44 2	12 55 18	12 56 27	...	...	...	12 58 45	2½ drs. of chloroform.
17	Pariah slut, nearly full grown.	1 6 0	1 8 45	1 11 51	1 12 32	1 12 15	...	...	1 17 20	3 drs. of chloroform used. Artificial respiration; no effect after pulse stopped, and heart barely audible.

SERIES IV.—(41 EXPERIMENTS)

APPENDIX NO. IV.—*Rapid poisoning of dogs with large doses of chloroform; no air allowed.*

No. of experiment.	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart stopped.	Remarks
1	Large-sized, healthy pariah dog.	H. M. S. 1 43 30	H. M. S. 1 44 24	H. M. S. 1 46 22	H. M. S. 1 46 48	H. M. S. ...	H. M. S. ...	H. M. S. ...	H. M. S. 1 50 30	2 oz. of chloroform.
2	Large-sized, full-grown, healthy pariah dog.	11 44 0	11 46 20	11 48 20	11 48 45	...	...	...	11 52 8	2½ oz. of chloroform
3	Healthy, full-grown pariah dog.	12 7 0	12 8 5	12 8 40	2 9 14	For a few seconds (10) the pulse returned and then ceased altogether.	Spasmodic action of abd. muscles took place at 12-10-50.	...	12 12 10	3½ oz. of chloroform (nearly 4) after stoppage of respiration
4	Large-sized, healthy, full-grown pariah slut.	12 21 30	12 22 32	12 23 45	12 24 48	...	...	...	12 27 50	6 drs. used in one dose
5	Full-grown, healthy pariah dog.	1 54 45	1 55 53	1 55 30	1 57 48	...	...	...	1 59 30	6 drs. ditto
6	Old, but healthy, pariah slut.	2 5 30	2 6 40	2 7 47	2 7 55	...	...	...	2 11 12	6 drs. ditto
7	Small-sized, but full-grown, pariah slut.	2 16 45	2 17 52	2 19 35	2 19 40	...	Pulse returned feebly at 2-21-40 for a few seconds.	Spasmodic action of abd. and thoracic muscles occurred	2 24 10	6 drs. ditto
8	Ditto ditto	3 0 0	3 1 20	3 5 15	3 6 25	...	...	...	3 9 42	6 drs. ditto.
9	Healthy pup, eight months old.	12 27 23	12 28 9	12 29 0	12 29 15	...	...	...	12 31 0	6 drs. of chloroform.
10	Lean pup, eight months old.	12 42 45	12 43 20	12 44 20	12 44 25	...	...	...	12 46 20	6 drs. of chloroform.
11	Full-grown, healthy pariah dog.	12 50 18	12 51 11	12 54 55	12 55 30	12 55 50	12 59 25	1 0 20	...	Artificial respiration after stoppage of pulse; successful.
12	Full-grown pariah dog.	1 3 55	1 5 3	1 5 13	1 6 40	...	...	...	1 8 7	6 drs. of chloroform.
13	Healthy pariah, eight months old.	1 13 0	1 14 30	1 15 40	1 15 59	...	...	...	1 17 17	1½ oz. of chloroform used.
14	Ditto ditto	1 27 18	1 27 48	1 28 50	...	...	...	...	No record taken; died.	Galvanism tried from the time respiration ceased till 1-33-0; no effect; 6 drs. of chloroform used.
15	Healthy pariah pup.	1 35 11	1 35 37	1 36 38	1 36 53	...	...	...	Do.	Galvanism tried from 1-36-33 for five minutes; no effect; 6 drs. of chloroform.
16	Healthy, full-sized pariah dog.	1 43 30	1 44 0	1 44 50	1 45 7	...	...	...	Do.	Galvanism tried for five minutes; no effect; 6 drs. of chloroform used.
17	Healthy pariah pup.	1 49 8	1 49 39	1 50 40	1 50 50	...	...	...	1 52 9	1 oz. of chloroform.
18	Ditto ditto	1 52 45	1 53 20	1 54 32	1 54 58	...	...	...	1 56 6	5 drs. of chloroform.
19	Full-grown, healthy pariah dog.	1 2 10	1 4 8	1 5 45	1 6 30	...	...	...	1 9 10	1 oz. of rum and 1 oz. of water given, 10, before inhalation; 6 drs. of chloroform.
20	Large-sized, full-grown pariah dog.	1 31 30	1 33 17	1 36 4	1 38 5	...	...	...	1 45 6	Same quantity of rum and ½ oz. of chloroform used.
21	Old, but healthy pariah slut.	2 5 15	2 6 28	2 11 36	2 12 4	...	...	...	2 14 33	Same quantity of rum, ½ oz. of chloroform.
22	Powerful, full-grown Binjari dog.	2 29 10	2 31 22	2 34 26 Inhalation was now stopped, but the dog breathed again. Chloroform was renewed till respiration ceased again at 2-41-30.	2 42 12 2 49 20	...	...	...	2 45 12	Same quantity of rum, 1½ oz. of chloroform.
23	Healthy pariah pup, five months old.	2 47 40	2 48 28	2 49 20	2 49 25	...	...	...	2 52 6	No rum given; 2 drs. of chloroform.
24	Healthy pariah pup, five months old.	2 53 20	2 53 52	2 55 2	2 55 18	...	...	...	2 57 48	No rum; 2 drs. of chloroform.
25	Healthy full-grown pariah slut.	12 49 14	12 50 30	12 52 5	12 53 51	...	...	...	12 56 30	1 oz. of rum given with water; 6 drs. of chloroform.
26	Large-sized Binjari dog.	1 12 0	1 13 42	1 23 10	1 24 5	...	...	...	1 25 42	Same quantity of rum; 1 oz. of chloroform in 1 dr. doses.
27	Full-grown, healthy pariah dog.	1 40 9	1 42 40	1 46 30	1 49 3	...	...	...	1 52 9	Same quantity of rum; 5 drs. of chloroform.
28	Large-sized, healthy pariah dog.	2 11 0	2 13 30	2 15 30	2 17 52	...	...	...	2 18 45	½ oz. of rum given; 7 drs. of chloroform.
29	Healthy, full-grown pariah slut.	2 24 15	2 25 10	2 27 0	2 28 45	...	...	...	2 30 15	2 drs. of rum given; 6 drs. of chloroform.
30	Ditto ditto	2 41 50	No record taken.	2 51 20	2 52 55	...	...	...	2 54 48	½ oz. of rum, 1 oz. of chloroform.
31	Healthy, nearly full-grown pariah dog.	11 52 45	11 53 32	11 56 37	11 57 12	...	...	...	11 53 35	2 drs. of rum, 2½ drs. of chloroform.
32	Healthy, large-sized pariah slut.	12 15 10	12 16 30	12 21 48	12 22 15	...	...	...	12 25 40	½ oz. of rum, 7 drs. of chloroform.
33	Powerful full-grown pariah dog.	12 47 0	12 48 18	12 43 40	12 50 16	...	...	...	12 51 15	½ oz. of rum, ½ oz. of chloroform.
34	Old large-sized pariah dog.	1 5 35	1 7 22	1 10 0	1 10 40	...	...	...	1 12 33	2 drs. of rum, 6 drs. of chloroform.

No. of experiment.	Description of dog.	Inhalation commenced.	Fully under chloroform.	Respiration ceased.	Pulse stopped.	Artificial respiration commenced.	Pulse returned.	Natural respiration re-established.	Heart stopped.	Remarks
35	Lean, full-grown pariah dog.	H. M. S. 11 23 0	H. M. S. 11 24 6	H. M. S. 11 26 40	H. M. S. 11 27 15	...	...	...	H. M. S. 11 28 45	3 drs. of rum, 3½ drs. of chloroform.
36	Full-grown, healthy pariah dog.	11 52 10	11 55 7	11 55 17	...	...	11 55 54	11 59 45	...	3 drs. of rum, 3 drs. of chloroform. Artificial respiration after stoppage of respiration; successful; 3 drs. of chloroform used.
37	Full-grown, powerful pariah dog.	12 5 19	12 6 34	12 7 28	12 8 8	...	...	...	12 10 23	—
38	Ditto ditto	12 20 10	12 21 30	12 24 6	12 24 38	...	...	...	12 28 10	3 drs. of chloroform used.
39	Lean, small-sized pariah dog.	12 32 40	12 34 18	12 37 40	12 39 19	...	...	...	12 41 6	½ oz. of chloroform used.
40	Healthy, small-sized pariah slut.	12 45 45	12 46 22	12 49 2	12 49 55	...	...	...	12 51 10	3½ drs. of chloroform used.
41	Full-grown, healthy pariah dog.	12 55 8	12 56 50	1 0 34	1 1 17	...	...	...	1 3 2	½ oz. of chloroform used.

REPORT
OF
THE LANCET COMMISSION
APPOINTED TO INVESTIGATE THE SUBJECT OF THE
ADMINISTRATION OF CHLOROFORM AND OTHER ANÆSTHETICS
FROM A CLINICAL STANDPOINT.

INTRODUCTORY.

TO see how far these facts arrived at by direct experimentation were true of human beings THE LANCET Chloroform Commission was undertaken. It is proposed, as far as is possible, to bring the results arrived at from its records into line with those given above. In the Clinical Report, however, various other questions intruded themselves, and an attempt was made to find satisfactory answers to them. Thus it was recognised that the higher we travel in the scale of organised beings the more complex does the Chloroform problem become. A very simple cause will produce a correspondingly simple result in simply organised animals, but will give rise to complex results in complex beings. It was further thought that among human beings many mental states might produce deaths attributed to an anæsthetic, or if not producing might act adjutantly to the effect of the anæsthetic. Again, an attempt was made to classify the cases of fatalities. Those which appeared after careful consideration to have been due to the anæsthetic directly formed one category, while those due only in some degree to the anæsthetic were placed in a class termed "remotely due to the anæsthetic." Many cases came under the notice of the Commission which did not result in death, but in which very dangerous complications arose from the use of the anæsthetic, and these were classed as untoward cases.

In the report of the experiments made upon the lower animals the conditions of the experiments were determined by the experimenters, were carefully preplanned, watched, and noted on revolving cylinders by mechanism, uninfluenced by bias, fear, or hurry. In these cases no liability to alter or forget facts occurred. In the cases dealt with by the Commissioner in the Clinical Report the actual conditions of any given case were not always easily recognised; the facts, as stated, were in some instances contradictory; and the conclusions drawn by the narrators of the cases appeared in some cases hardly compatible with the facts they reported, and tinged rather by habitual beliefs than by a calm review of their report.

The Report aimed at being in part statistical, as no attempt had been made previously to ascertain the number of times the various anæsthetic agents had been employed, and it was deemed most important that when stating that so many deaths or accidents had occurred under any one anæsthetic, while so many had followed the use of any other, that some basis of comparison should be given by ascertaining how many times the one agent was administered, and how many times the second was, in order that the proportion should be ascertained between the deaths or accidents happening in these two cases. If, for example, one death under an anæsthetic A, occurred to five deaths under an anæsthetic B it was essential to discover whether B anæsthetic was given five times as frequently as anæsthetic A, for in that case the mortality under these agents would in fact, be equal, although apparently in the proportion of five to one.

The Report on the clinical aspect of the question dealt with answers obtained in response to a form of enquiry issued to the members of the profession.

The form desired information on the following points:—

What anæsthetic do you usually employ, and how? (Apparatus?) Average number of times a year? Do you keep an accurate register? What class of cases (operation, midwifery, &c.)? Can you give particulars of any deaths? Agents used? Apparatus? Nature of operation? Age, sex, and peculiarities of patient? Posture? How long under? Did heart or respiration stop first? If a post-mortem, particulars? Can you give particulars of any dangerous cases and means used for resuscitation? Please give particulars as above. Signed (). Address (). Qualifications and school ().

A form of larger size was in addition sent with a like request to each hospital of the United Kingdom containing more than ten beds. Further, this form, accompanied by a circular letter couched in the language of the country to which it was sent, was despatched to all the larger hospitals of the Continent, as well as to India, America, and the Colonies.

This form asked for information in the following way:—

Name of institution. Approximate number of times anæsthetics have been given during the past ten (1) years. Chloroform used and for what cases. Relative frequency: (a) ether and for what cases; and (b) mixtures (name) and for what cases. Other anæsthetics. Deaths under anæsthetic, how many, and under what anæsthetic. Particulars of death; sex; age of patient; operation; how much anæsthetic used; duration of administration, &c.; by whom given. Other particulars as to experience of institution as to relative dangers of anæsthetics: (1) at operation; and (2) after operation, and facts bearing on this question.

As, however, the records received in reply to these circulars (Series C) for the most part bore reference to recent cases, these sources of information were supplemented by a careful search for particulars concerning dangerous and fatal cases under anæsthetics reported in the current professional and lay papers (Series B). The reports thus obtained were thoroughly sifted by collation of the various accounts, and, when possible, by reference to the reports tendered to us by medical men. As to the value of such narratives being lessened for want of the personal guarantee of accuracy of the details by the administrator, it should be borne in mind that in by far the largest number of cases the particulars were usually given on oath before a coroner's court, and, further, at any rate in the case of medical journals, were conveyed to the press not through newspaper clippings, but directly from the responsible administrator or surgeon. When this was not the case particulars were usually asked

for and, when possible obtained from the medical man interested in the case.

In order to arrive at a continuous series of cases from 1847 (the date of the first employment of chloroform as an anæsthetic), not only were the above sources of information used, but the records of Snow¹—a most valuable and carefully kept sequence—and those collected by the committee of the Royal Medical and Chirurgical Society, published in their Transactions in 1864 (vol. xlvii.), were laid under contribution and again collated with the records derived from the other sources (Series A).

The authorities of some of the large hospitals (Series C) very courteously permitted our Commissioner to inspect their case-books and to extract cases from them which had not appeared in the circulated forms or in any published works. Further information was in this way also obtained concerning cases already recorded. The records supplied by the Registrar-General of Deaths further gave additional information of casualties under anæsthetics. It seems from reference to these tables that more deaths from anæsthetics are recorded by the Registrar-General than are to be found in any other published records or in the private records kept by some of the hospitals.

As regards Scotland, the present condition of the law as to inquiries into the circumstances of deaths under anæsthetics greatly interferes with accurate information being obtained upon this matter.

CLASSIFICATION OF CASES.

In arranging the report we have found it necessary to deal with chloroform, ether, mixtures of anæsthetics, the less common forms of anæsthetics, such as bromide of ethyl and nitrous oxide. The reports of cases have been divided into the following classes: (1) deaths under and apparently due to an anæsthetic; (2) deaths under and remotely due to an anæsthetic; and (3) untoward cases—i.e., cases in which some mishap occurred which was not followed by fatal results, but which was directly or remotely due to the anæsthetics employed. To illustrate our meaning we may cite some illustrative cases.

1. A patient, after inhaling chloroform for five minutes and just before the beginning of the operation, suddenly turns pale, his respiration stops, and in spite of all restorative measures he dies. Here, if the patient is completely under the anæsthetic, and if other causes of asphyxia are absent, the death may fairly be ascribed as due to the anæsthetic, and would be classed in the first of the above categories.

2. If a patient passes through the narcosis and operation satisfactorily, but after resuming consciousness dies as a result of some intercurrent complication, such as severe vomiting, bronchial or pulmonary catarrh or inflammation, the death is classed among "remote deaths" in our second category, and that even although such deaths are frequently attributed to the anæsthetic. It is clear the result can only be remotely due to the agent employed. For a parity of reasoning deaths from the administration of ether after some days, and due to renal complications, are classed as remotely due to the anæsthetic.

3. If, while under an anæsthetic, the patient suddenly becomes faint or asphyxiated, or in some other way passes into a dangerous condition, and this is brought about directly by the anæsthetic, the case is, should the patient eventually recover, put into the category of "untoward cases."

When, however, the dangerous condition is due in part only to the anæsthetic, and in part to other circumstances, the case is then classified under the head of "untoward cases remotely due to the anæsthetic." The conditions affecting hospital patients and persons operated on out of hospitals being often very different, an attempt has been made to compare these two classes of persons, and so revealing similarities or dissimilarities they evinced under the influence of anæsthetics.

A further question necessarily not arising in the Report of experiments is how far do *climate* and *race* and *geographical distribution* affect the deaths under anæsthetics. Are some peoples immune or less liable to deaths under anæsthetics than others? Do the thermometer and barometric curves in any way give data bearing on our inquiry?

Sex and age, again, are conditions which have by many been placed as having very great importance in the estimation

of risk under anæsthetics. It was assumed at one time that young children, aged persons, and parturient women were immune from chloroform poisoning.

Predisposing causes for deaths have also been asserted to exist in cancer, in alcoholism, and emphysema, and these allegations have been studied in this connexion.

The *determining causes* for death under anæsthetics as assumed to exist by different schools of thought—e.g., paralysis of respiration, primary cardiac syncope, over-dosage and vomiting occurring during the administration of the anæsthetic—have all been carefully dealt with and the results tabulated.

A very considerable degree of importance in the case of chloroform is attached in the experimental inquiry as to whether the respiration or the circulation failed together or one before the other, and, as we have pointed out above, the result arrived at in the case of the lower animals in the experiments performed at Hyderabad was that respiration failed before circulation. In view of this, great care was taken to consider this question from the clinical standpoint, and the facts were arranged in such a way as to make "it easy to arrive at the results given by the clinical inquiry."

It was at one time assumed that deaths under chloroform were due to an "idiosyncrasy," and hence it was believed that if a person had taken chloroform once without harm he was practically safe upon any subsequent occasion. In the Report, therefore, special mention is made of all cases of deaths occurring in persons who had previously been chloroformed. Of course, in very many instances the notes supplied to the Commission do not supply information upon this point, so that while the cases cited are of value, it cannot be assumed that the preponderating cases in which chloroform is not mentioned as having been given before are necessarily "first cases" of chloroformisation. Considerable importance is justly attached to the methods employed in resuscitating those in danger from or during anæsthetisation, both in the experimental and in the clinical part of the present report. In the experiments on the lower animals it was found that the only successful plan was artificial respiration, and that this only succeeded within certain well-defined limits. When the chloroform was given slowly and the respiration was complicated by hampered air exchange the chances of recovery were less. Artificial respiration was generally successful if commenced within thirty seconds—seldom so after thirty to sixty seconds, and never if began after the lapse of sixty seconds. Morphine, if injected before the chloroform was given, lessened the chance of resuscitating by artificial respiration the animal overdosed with chloroform.

The fact that only respiratory difficulties were met with in the experiments upon the lower animals must be borne in mind when the failure of inversion (see above in Hyderabad Report p. 8) (Nélaton's method) and other plans usually adopted in dealing with presumed circulatory depression is considered.

Shock has been very carefully considered from both the experimental and the clinical aspect. While the experiments recorded (p. 7) showed but little effects in the lower animals from "surgical shock," the clinical record was considered under various headings. Thus a full tabulation of operations was made to ascertain as far as possible whether those procedures usually associated with severe shock gave evidence of increased liability to death from anæsthetics. It was recognised in the course of the drawing up of the Report that very many deaths occurred before any operation was commenced, and the likelihood of "fear shock" was in these cases considered.

In many cases a more or less precise account of the post-mortem appearances were given, and these have been carefully tabulated for reference. They serve as a valuable commentary to the history of many of the cases, but do not in every case corroborate the view taken by the recorder of the death. In drawing up these tabulations very great care has been taken to avoid drawing inferences or giving facts save such as are directly the statements of the observers who reported the cases. The anæsthetics are considered under their separate headings, and although many are given the main interest of the report attaches to chloroform and ether. Chloroform is therefore taken first, and the facts about it arranged according to the above plan; ether is taken next, and finally the less commonly employed mixtures and anæsthetics. A comparison of these, in so far as they impinge, is instituted, and such conclusions as appear to follow from the facts as recorded complete the Report.

¹ On Anæsthetics, 1858.

THE LANCET CLINICAL REPORT.

PART I.—CHLOROFORM.

AGE AND SEX AS DETERMINING FACTORS.

Taking up these questions as they arise, we now proceed to endeavour to discover, by means of our carefully collated figures obtained from the sources which we have mentioned, whether age and sex have any determining influence on fatal cases under chloroform. We find that no age possesses immunity. Taking periods of five years between birth and the age of seventy-five, the extremes reached by the statistics before us, we see the proportion between the sexes to be as follows:—

Proportion of Fatalities of Males to Females.

Ages.	Proportion. Males, Females.
1 to 5 years	7 to 2
5 to 10	19 to 5
10 to 15	15 to 6
15 to 20	equal.
20 to 25	26 to 15
25 to 30	22 to 6
30 to 35	17 to 8
35 to 40	17 to 7
40 to 45	34 to 11
45 to 50	34 to 9
50 to 55	13 to 3
55 to 60	24 to 7
60 to 65	no females.
65 to 70	equal
70 to 75	2 to 1

According to these figures, the greatest number of deaths in males appears to take place between the ages of twenty-five and fifty, a period of life when men are most liable to injuries and surgical diseases. The fatalities of women are most frequent between the ages of twenty-one and forty-five, a period which includes the epoch of parturition and the age at which operations for carcinoma are most commonly performed. In drawing any conclusions from the above figures it must be carefully remembered that they only represent the proportion of deaths of males to females under chloroform, as reported to the Commission, and do not represent a proportion of deaths in an equal number of inhalations by males and females. Probably many more males are compelled to take chloroform for the performance of surgical operations arising from accidents than obtains in the case of women. Unfortunately, it is impossible for the Commission to do more than suggest this explanation of a seeming partial immunity for women, as until all cases of inhalation of chloroform are recorded, and some thousands of records, including an equal number of the sexes, are compared and classified as above, no absolutely reliable statistics will be procurable. At the same time it must be admitted that even if the proportion of deaths among men be not quite what the above proportion is, 23 males to 8 females or nearly 3 to 1, it seems highly probable that males are more prone to fatality than females. To obtain information upon this point statistics of the operations performed on the various London general hospitals were obtained, and it was found that for the ages given above a larger number of males than of females were subjected to operation.

GEOGRAPHICAL DISTRIBUTION OF CASES.

The subjoined table shows that practically no region is free from chloroform deaths. The greatest number of

fatalities followed no law of temperature, climate, or telluric influence, but was in almost direct proportion to the population. This statement, however, has to be modified as regards India, which, while returning records of a very large number of cases of operation, returns very few deaths. The Hyderabad Chloroform Report,* Part IX. quotes 326 cases of chloroform inhalation, and gives details of 53 cases and no fatality. Further, Surgeon-Lieutenant-Colonel Lawrie has never met with a single death during a long clinical experience in India. It is felt that no data of sufficient breadth at present exists to settle the very important points whether social traits, climates, or telluric conditions do in any way modify the effects of anæsthetics upon the human subject. It is manifest that temperature must and does act strongly in favour of anæsthetics. In the Hyderabad Report, Section 45, p. 30, attention is drawn to the impossibility of obtaining satisfactory anæsthesia by ether in hot climates—e.g., India. Other surgeons have pointed this out, and the causes which render ether too rapidly eliminated from the system to produce true narcosis would tend to prevent an overdose of chloroform being retained if it obtained entrance to the lungs.

AFRICA.	Kingston. Louisville. Madison (Co. Indiana). Manon (Ohio). Maryland. Mechanicsville. Michigan. Middleport (Ohio). Nashville. New Jersey. New Orleans. New York. Norfolk (Virginia). Olean (N.Y.) Omaha. Paducah (Kentucky). Philadelphia. Pittsburg. Place not named. Portland (Maine). Rahmay (New Jersey). St. Francisco. St. Louis. Sardinia (N.Y.). Sheffield (Mass.). Trenton (New Jersey). Tuscan. Virginia.	EUROPE.
Egypt (Suez). Whitelsea (Cape Colony).		AUSTRIA. Gratz. Vienna.
AMERICA.		DENMARK.
CANADA.		FRANCE.
Ancaster (Ontario). Dunville (Ontario). Halifax (Nova Scotia). Hamilton (Ontario). City. London (Ontario). New Brunswick. Quebec. St. John's (New Brunswick). Toronto. Toronto General Hos.		Boulogne. Bordeaux. Langres. Lille. Lyons. Orleans. Paris. St. Malo.
UNITED STATES.		GERMANY.
Atlanta (Ga.). Ballard Co. (Kentucky). Baltimore. Blackwell Island. Bloomington (Ill.). Boston. Brunswick (Maine). Buffalo. Canaan. Charlestown (South Carolina). Chicago. Chicago County Hos. Chicago Electric Col. Chicago Presbyterian Hospital. Cincinnati. Cleveland City Hosp. Columbus (Ohio). Cora Cramford Co. (Penn.). Cork County Hosp. Delhi (N.Y.). Denver. Harts Falls (near Boston). Jersey City.		Berlin. Bonn. Munich. Neustadt. Strasburg. Ulm.
		PORTUGAL.
		Lisbon.
		RUSSIA.
		Cracow, Poland. Crimea. Odessa.
		ENGLAND AND WALES.
		Accrington. Aldershot. Barrow-in-Furness. Bath. Birmingham. Birkenhead. Blackburn. Bootle. Bradford. Bridgeford. Brighton. Bristol. Broadmoor. Cambridge. Canterbury. Cardiff.
	ASIA.	
	Burdwan. Burmah. Hyderabad. India. Japan, Yokohama.	
	AUSTRALIA.	
	Adelaide. Brisbane. Burra. Dunedin. Hamilton. Melbourne. New Zealand. Ovens District. Provincial. Tasmania. Town. Pentridge. Sydney.	

* Reference is here made to the Edition published in Bombay 1891.

Carlisle.
Chelmsford.
Chester.
Chipping Norton.
Cirencester.
Cornwall.
Croydon.
Cumberland.
Dawlish.
Derby.
Derbyshire.
Devonport.
Doncaster.
Dorking.
Dudley.
Epsom.
Exeter.
Exmouth.
Gloucester.
Guildford.
Guilford.
Handsworth.
Hartshill.
Hartlepool.
Huddersfield.
Hull.
Ipswich.
Keightley.
Leeds.
Leicester.
Lincoln.
Liverpool.
Llanelli.
Long Eaton.
London.

Maidstone.
Malvern Wells.
Manchester.
Mildenhall.
Nelson.
New Brighton.
Newcastle.
Normanton.
Northampton.
Norwich.
Nottingham.
Oxford.
Peterborough.
Plymouth.
Portsmouth.
Preston.
Quarry Bank.
Rainham.
Reading.
Richmond.
Rhyl.
St. Helens.
Salisbury.
Sheffield.
Shrewsbury.
Smethburgh.
Southampton.
Stalybridge.
Stafford.
Stockport.
Stock-Clemsland
(Cornwall).
Stroud.
Sunderland.
Swansea.

Taunton.
Tavistock.
Thorbury (Bristol).
Towcester.
Tunbridge Wells.
Turnhall (Hanley).
Twickenham.
Warley.
Whitfield (Kent).
Whitehaven.
Wilmslow.
Winton (Newcastle).
Wolverhampton.
Woolwich.
Wrexham.
York.

IRELAND.

Belfast.
Cavan.
Dublin.

SCOTLAND.

Aberdeen.
Alloa.
Dundee.
Edinburgh.
Girvan.
Glasgow.
Gowan.
Inverness.
Lasswade.
Melrose.
Penicuik.

The Mauritius.

METHODS EMPLOYED FOR ADMINISTERING CHLOROFORM.

One point which appeared to our Commissioner to be of manifest importance in the inquiry was whether any relation could be shown to exist between particular methods of giving chloroform and accidents under its use. If, for example, one method could be shown to be frequently accompanied by such accidents, such occurrences might be taken as indicative of a possible fault in the method. On the other hand, it was recognised that the problem was complicated by the fact that the methods not being employed with equal frequency, those most generally in use might, by showing more deaths or accidents, appear—and of course fallaciously—to be the more unsafe. It was necessary to guard against this form of error and to make allowance for it. The sequel appears to show that the method employed has really little influence in determining the result. The methods were divided into the following classes:—

1. *Those in which no special form of inhaler was employed.*—Under this heading the following modes of administration were specified, arranged in the order of their frequency.

Chloroform poured on a handkerchief.	
" " " lint.	
" " " a towel.	
" " " a napkin.	
" " " into an extemporised cone.	
" " " a sponge.	

In fewer instances the process is described as having been conducted by the "open method," or chloroform given from a "coil of paper," "cloths," "compress," and so on. The recorded deaths resulting from chloroform being administered without an inhaler are rather more than double those occurring when an inhaler is used; but from inquiries made at various hospitals and in private practice there is no doubt that the exhibition of chloroform without the use of an inhaler is much more frequent than is the employment of a distinct mechanical contrivance, such as Clover's or Junker's apparatus.

2. *Deaths under chloroform when a specified apparatus (inhaler) is employed.*—In the order of the frequency of deaths during their use the following inhalers are specified:—

"Inhaler" (kind unspecified).	Clover's inhaler.
Skinner's inhaler (a simple flannel mask stretched on a wire frame).	Esmarch's "
Junker's inhaler.	Metal cone.
Snow's "	Guy's Hospital inhaler.
	Morton's ether inhaler.
	Weiss's apparatus.

We have, however, no figures to show the number of times these inhalers are used, and in the absence of these there is no accurate basis for comparison in regard to their safety or danger. It appears that in some instances chloroform has, with fatal results, been given from an ether inhaler. The frequency of use of the above inhalers must be taken into account. Skinner's apparatus, from its simplicity and portability, is probably used very much more frequently than any other. Snow's and Clover's inhalers are seldom, if ever, employed at the present time. Skinner's, Junker's (in one of its several modifications), or some form of cone containing a sponge or piece of lint, probably represent the inhalers at present in vogue in the order of their frequency of employment.

It is a remarkable fact that in more than half the cases of fatalities reported to us no mention is made of the method which was followed in giving the chloroform, and even when the apparatus or method is named no particulars are furnished indicating the manner in which the anæsthetic was exhibited. That such details are essential the following example will indicate. Case A: "Open method"; chloroform "poured" on lint "after the manner of Syme," who taught that plenty of the drug should be used. Case B: "Open method"; chloroform "dropped" on lint after the manner advocated by the dosimetric school, who teach that by dropping chloroform literally *guttatim* on lint the utmost safety is ensured. Here two methods diametrically opposed in principle are described by the same phrase, "open method." Each of these schools would hold the other responsible by the faulty character of their method for any mishap occurring during the chloroformisation.

The cases recorded as having occurred in the above countries or towns have not only occurred in hospitals, but the record takes account also of cases occurring in private practice. In attempting to deduce any conclusions from the above table of localities from which deaths were reported the same difficulties have arisen as were mentioned in dealing with the subject of the influence of age and sex on mortality under chloroform. The extent of population, hospital accommodation, and the proportion of medical men and their facilities for operations enter largely as disturbing factors into statistics of this kind. Again, it must be assumed that the records of fatalities or dangerous cases would be more accurately kept and be more accessible in the larger European or American towns than, for example, in African or in small outlying Canadian towns. The readiness with which chloroform is given in a London hospital is in marked contrast to what obtains in smaller towns, even in England, and still more so in remote hamlets elsewhere. Another disturbing factor is the unwillingness of some persons to record fatalities under chloroform. We have above also noticed the fact that in Scotland, where chloroform is so widely and extensively employed, few reliable sources of information exist of the deaths which result from its exhibition. It has, however, been thought advisable to introduce into the Report the above list of places as well as other tables and lists, in the hope that they may afford a guide for further investigations both in the way of directing attention to statistics desirable, but at present inaccessible, and in discountenancing a loss of time over equivocal arguments based upon unsatisfactory and fallacious premises.

In further reference to race and the influence of climate it must be admitted that there are no materials upon which to base any conclusive arguments. The only satisfactory way to deal with this question would be to compare, not 50,000 cases occurring in the practice of one surgeon in one clime with an equivalent number of cases of another surgeon in a country sufficiently remote to ensure differences of race, mode of life, of temperature and environment, but a sufficiently large number of cases in different countries occurring in the practice of a sufficient number of persons to eliminate individual failings or extra care in the administration of the anæsthetic. It would, for example, be valueless to institute a comparison between the individual practices of two surgeons, one of whom operated almost solely on cases of minor surgery, whilst the other was constantly called upon to deal with the graver and more prolonged procedures of surgery as are called for in large and populous towns, especially those in which machinery accidents are rife. It seems more than probable that the manner of life, the individual habits, in other words, the *resistive force* of the individual plays a most important part in the question. This factor is influenced not only by race, since racial traits determine or are determined by climatic and telluric environment, but also the way in which life is passed, and habits, good or bad, are formed.

CAUSES ASSIGNED FOR DEATH.

In giving the causes which are stated by the original reporters of the cases to have occasioned death, care has been taken to present if not the exact words at least the exact sense of the words employed. This has been done to avoid any bias which might unconsciously attribute results following upon well-defined symptoms. A careful examination of the cases, both in the following abstracts and more especially in the cases given at length, will show that in most instances the causes assigned are very complex, and no very definite single cause is advanced by itself. It is seldom that any single issue, such as failure of respiration or failure of the heart, appears to have arisen in the minds of the reporters of the cases. In some few instances the causes alleged do not appear to correspond with the symptoms given, but even here strict attention has been paid to the narrator's views, whilst notice is at the same time drawn to the discrepancy and an explanation offered. In drawing up this summary the greatest difficulty has arisen in many cases from the looseness and inadequacy of the published records. It has been necessary in some instances to place apparently similar cases under different headings when the causes assigned for death have been different, although the lesions have been similar. Thus, in one case death is attributed by the narrator to syncope, although it is stated that food *was found in the windpipe*, which, it may be presumed, caused respiratory trouble, leading, it may be, to syncope as an ultimate result. In drawing up the abstracts from the reports of cases these sources of error have been eliminated, as far as possible, by assigning the evident and immediate cause of death, and not the remote one. In the case alluded to above no one would accept "syncope" as the true cause of death, except in the sense that dissolution must always be eventually associated with cessation of the heart's action. The causes of death further seem in many cases to be capable of being classified under the heads—(1) Predisposing, and (2) Immediate. A person who presumably would pass through chloroform without danger or difficulty may, it is believed by many, be so predisposed to death through the action of chloroform that they die under its influence even when but a small quantity is given and no complications *quâ* the anæsthetic are present.

PREDISPOSING CAUSES OF DEATH UNDER CHLOROFORM.

Of these, alcoholic abuse, wasting diseases, emphysema of the lungs, and the occurrence of vomiting are dealt with here. In the records of necropsies (p. 96 *et seq.*) further reference will be found to these conditions.

Intemperance.—It has been widely recognised that persons addicted to excesses in alcoholic liquors take anæsthetics badly and run peculiar risks. In the cases reported in the press we find a definite record of intemperance in twenty-four males and five females and a doubtful record in three males. In the records sent to us from medical men of deaths occurring in private practice under chloroform, we find it existent in the cases of one male, two females, and in the equivalent list from hospital practice in three males, and in the records obtained from the private statistics kept in hospitals we find mention of one male. This gives a total of thirty-nine. The oedematous condition of the tissues, their lowered vitality, and the large doses of chloroform commonly taken by alcoholics before "going over" are possibly some of the reasons why these people are so prone to chloroform death.

Wasting Diseases.—The various forms of wasting diseases, it is assumed, by tending to lowered vitality would predispose to chloroform death. Comparatively few returns, however, were made under this head. Although cancer was present in many cases, only in nine cases it is mentioned as having been a possibly predisposing cause of death. And, on the other hand, it is matter of common observation that it is by no means the old and feeble or those wasted by prolonged disease who fall victims to chloroform.

Emphysema.—The existence of this condition, a presumably dangerous factor, is mentioned in twelve cases. The impairment of respiration and presumable danger of accumulation of chloroform vapour in the lungs through lessened expiration may, it is believed by many, predispose to death by overdose.

Vomiting.—Vomiting during the operation is noted as having occurred eighteen times. There are several points of interest about this statement. First, vomiting shows either loading of the stomach before the administration of the anæsthetic—a procedure about the danger of which there can be no question, both from general shock and from the danger lest the vomit be sucked back into the air passages; and, secondly, the probability that an insufficient quantity of the anæsthetic was given, and that the patient consequently suffered from the shock both of the operation and of the chloroform.

IMMEDIATE CAUSES OF DEATH.

In preparing the following summary the greatest difficulty was experienced. Without great care merely supposititious causes for death might have been inserted. To avoid this the statements of the recorders of the deaths were taken as the absolute criterion even when the Commissioner felt that the evidence did not admit of the conclusion at which the original recorder had arrived. In the majority of cases, however, the reports are clearly given, and it is emphatically stated that a particular cause or particular causes were directly responsible for deaths.

In the cases collected by the Royal Medical and Chirurgical Society and supplemented by Dr. Snow's records the results are grouped: (1) under failure of respiration; and (2) causes associated with cardiac failure; and contributing causes are added in brackets. In the following summary, when a note of interrogation is added it means that the cases, although probably, as the records seem to indicate, instances of the particular lesion mentioned, yet, as the account shows, some doubt existed in the mind of the original reporter. Its meaning may be taken as an equivalent to the words, "probably" from overdose, "probably" from syncope, &c., as the case may be.

In Series A phenomena assigned as causes of death:

FAILURE OF RESPIRATION in 3 cases; ditto probably from overdose in 3 cases; ditto from holding of breath, 1 case; ? of failure of respiration, 20 cases; ? ditto due to holding of breath and ? overdose, 2 cases; ? ditto ? due to overdose, 3 cases. Thus giving 32 cases of probable failure of respiration as cause of death.

SYNCOPE (failure of circulation). Shock ? due to syncope in pre-anæsthetic stage, 4 cases; ditto shock in ? incomplete anæsthesia, 1 case; ? ditto ? shock, 5 cases; ? ditto with ? shock during imperfect anæsthesia, 5 cases; simple syncope in 3 cases; ? simple syncope in 28 cases; ditto associated with incomplete anæsthesia, 2 cases; ditto ? with overdose, 1 case. This gives a total of 49 cases in which the death is assigned to some form of cardiac syncope.

In Series B a far wider range of causes is assigned. Thus: air in blood vessels, ditto in veins, alcoholic coma, severe anemia, each 1 case; apoplexy—cerebral, 2 cases, ditto, 1 confirmed by necropsy; "meningeal apoplexy," 2 cases; asphyxia in 11 cases—1 from respiratory failure, 1 from pulmonary abscess associated with consolidation and pleural adhesions, 1 due to an aneurysm pressing upon the trachea and entrance of blood into the air passages, 2 to congestion of the lungs, 1 from emphysema causing respiratory failure, 1 from epileptiform convulsions causing fixation of the chest walls, 1 from injury to the larynx with air entering blood-vessels, 1 associated with syncope from diseased heart, 1 from thyroid enlargement, 1 from vomit entering air passages; respiratory death in 2 cases due to convulsions (in a lunatic) associated with fatty degeneration of organs; and 1 case due to emphysema with collapse of lung; failure of respiration 5 cases; 2 from muscular spasm; no other reason assigned in 2, and in 1 associated with syncope. Failure of respiration and of heart 6 cases; 1 in which aneurysm of the innominate artery existed; one in a drunkard; one from "fear"; one in which heart was dilated and lungs congested; one in which marked emphysema existed; and 1 from fatty embolism in an imtemperate anæmic person.

The following 55 cases are classed under HEART FAILURE. 1 case of cancer of the myocardium; 1 heart dilated and flabby; 1 distended heart with bronchitis and fatty kidneys; 5 "heart diseased"; and 1 "heart and lung diseased"; diseased heart, pericardium and arteries, also "insufficient anæsthesia." In 13 cases "fatty degeneration" is given alone, and 31 of fatty degeneration associated with

"death due to anæsthetic" (1 case); bronchocele, food in stomach, alcoholism; dilated heart; feeble, but no organic disease; flabby heart; hypertrophied; malformed; over-distended with violent struggling; paralysis of heart; diseased heart; emaciation; atheroma of coronary vessels; enlarged heart with emphysematous lungs, due to fear; "incomplete anæsthesia"; reflex inhibition of heart; pericardial adhesions; "spastic contraction of heart, the effect of chloroform in ganglionic nervous system"; "spastic contraction of heart (weakened by loss of blood)."

In 9 cases "Syncope" is given as the cause of death, but no mention is made of heart disease. The following additional causes are added: alcoholism; asphyxia (very anæmic); atheroma of coronary arteries; right heart thin; dilated heart; emphysema of lungs, brought on by excitement; epilepsy; feeble child; feeble patient; fright; general feebleness.

In 154 cases "Syncope" is assigned as the cause of death, but it occurred in persons in whom cardiac or pulmonary disease existed and presumably were adjuvant in bringing about the fatal result: degeneration of the muscular structure of the heart muscle; mitral and aortic valvular disease; "valves" diseased; disease of heart not further specified (2 cases); diseased coronary arteries; diseased heart and lungs; alcoholic, struggling; distension of right side of heart; fatty degeneration (20 cases); alcoholic, syphilitic patient; excessive fatty degeneration; slight fatty degeneration; dilated heart (38 cases); dilated heart with struggling; dilated heart, thin atheromatous valves and arteries; diseased heart; kidneys diseased, drunkard; imperfect anæsthesia (3 cases); lungs diseased; lungs cedematous and kidneys granular; struggling (21 cases); thin walls of heart; flabby walls of heart; flabby and weak; malformation of heart, kidney disease; "paralysis of nerves of heart"; thin walls; thin walls, lungs tuberculous, intemperate; kidneys diseased; lungs diseased; ? operation (ovariotomy) due to shock (2 cases); ? reflex; shock (emptying empyema); shock from brain injury; ? sitting up (2 cases); ? weakly (very), alcoholic; arteries disease of; ? asphyxia (valvular disease); heart, dilated thin walls; dilated thin walls, only one coronary artery; diseased walls (4 cases); diseased (aortic valvular disease) and dilated heart; diseased heart and kidneys enlarged; "fat on heart," diseased aorta; with emphysema, bronchitis; heart slightly dilated; hypertrophied heart, emphysema; intemperate patient; kidney disease; "soft heart"; feeble, "too strong a dose"; flabby heart; hypertrophied, emphysema; thin walls; thin walls, diseased arteries; dilated aorta; malignant disease; ? overdose; weakly infant (lungs never properly inflated); larynx, spasm of. Heart diseased, associated with—lungs, paralysis of ("fatty heart"); lungs, tuberculous; lungs and pleura, abscess consolidation; respiration, obstruction to, by pharyngeal growth; respiratory centre, paralysis of (2 cases); respiratory muscles, heart dilated, albuminuria.

Five cases are classed as death due to brain lesions—viz., "abnormal state of brain due to chloroform"; direct poisoning of nerve centres; effusion of blood into brain caused by vomiting; subarachnoid hæmorrhage (?) from struggling. Associated with brain conditions—1 from congestion of the lungs; 1 due to convulsions in a patient the subject of fatty degeneration; 1 to emphysema and collapse of the lung, 1 from exhaustion and 1 in labour. In 16 cases "shock" is the reputed cause of death associated with hæmorrhage in 1 case; with a fatty and dilated heart in 1 case; in a very feeble patient; not completely under the influence of the anæsthetic in 2 cases; in a leucæmic patient; reflex shock in 1 case; a reputed reflex shock in another; rupture of stomach in 1 case; subarachnoid hæmorrhage in 1 case; tetanus in 1; thrombosis in 1; vomit entering air passages in 2 cases; vomiting, veins in pia mater and viscera gorged; ? valvular disease, heart pale, mitral thickening, aortic atheroma in 1 case.

HEART FAILURE AND RESPIRATORY CESSATION.

Owing to the grouping of the causes assigned with subsidiary or adjuvant causes of death, the summary just given is less clear to a superficial inspection than would have been the case had one leading cause been assigned. To elucidate the point under consideration—viz., the cause of death—a further tabulation is offered which has been arrived at from such figures and statements as we have had at our disposal, in which the relative frequency of the heart failure and respiratory cessation is compared.

Of the 506 records of cases which have come under our notice in this connexion the pulse is stated by the person who reports the death to have failed first in 143 instances, while in 59 records the respiration is described as being primarily stopped; in 46 it is mentioned that the respiration and circulation (as judged by the pulse) ceased simultaneously; whilst in 26 the pulse probably, it is asserted, failed first in 4 the respiration probably failed first, and in 12 they probably failed simultaneously; in 211 cases no record was given as to which failed first. The word "probably" needs some explanation, lest it should appear that an unscientific nomenclature had been adopted. In many of the records of cases the reporters have expressed their opinion, more or less strongly, that either the pulse or respiration ceased first or simultaneously. In those cases in which no direct and distinct affirmation was offered although evidence exists indicating the order in which respiration and circulation failed, we have used the qualifying word "probably," indicating it both in the tables and in the summary by the inserted note of interrogation, thus—(?).

Of the cases collected by the Committee of the Royal Medical and Chirurgical Society (Series A), out of 83 cases 26 are given in which the pulse failed first, 4 in which respiration failed first, 11 in which respiration and circulation failed simultaneously, 9 in which the pulse probably failed first, 2 in which the respiration probably failed first and 7 in which they probably failed simultaneously, while 24 cases had no record of these points. These results may be tabulated together with those derived from the records collected from the press, those obtained from private and hospital sources in response to THE LANCET inquiry form, together with those derived from the private statistics of hospitals (Series B and C).

	From the Medical and Chirurgical Reports.	Recorded Cases in Journals.	THE LANCET INQUIRY.		Hospital Cases not included elsewhere.	Total.
			Hos- pital.	Private practice.		
Pulse failed first ...	26	148	5 ... 2		2	183
Respiration failed first	4	57	7 ... 2		—	73
Pulse and respiration failed simultaneously	11	46	1 ... —		—	58
Pulse probably failed first	9	26	— ... 2		7	44
Respiration probably failed first	2	4	— ... —		1	7
Probably failed simul- taneously	7	12	— ... —		—	19
No record obtained ...	24	211	13 ... 1		4	253

It thus appears that while it is stated that in 183 cases the pulse failed before respiration and in 44 more it probably did so—i.e., in 227 instances—in 73 for certain and probably in 7 more, in 80 instances, respiration flagged first and became extinct, while the heart continued to beat. In 58 cases the action of the heart and respiration are said to have ceased simultaneously, and this seemed to have been the case in 19 other cases, or 77 in all.

Cardiac failure ...	...	...	227 times.
Respiratory failure ...	...	...	80 "
Simultaneous failure ...	...	...	77 "

In offering these figures we do not wish to be supposed to attach too much weight to them. They would seem to show that, from the clinical standpoint, heart failure is the commonest form of death from chloroform. Whether the evidence taken from such reports is in all instances admissible or reliable cannot be here considered, but the opinion of such men as Syme, Clover, and of leading hospital surgeons possessed of large experience, that in some cases death occurs through primary heart failure, cannot be ignored. It was pointed out in a preceding section that in some instances cases of deaths under chloroform are recorded as having been due to syncope, when from the symptoms and phenomena of the narcotism described there was a strong presumption in favour of the view that the death was really due to asphyxia. However, a very careful consideration of all the records which have been brought under our notice

would seem to favour the conclusion that in the large majority of cases the symptoms and phenomena detailed bear out the view that death was due to syncope *in so far as the clinical evidence could decide one way or the other.*

In dealing with the *causes* of death it will be remarked that no attempt has been made to tabulate information as to the *quantity* of chloroform used or its quality. These questions could not be dealt with by us, as little or no information was given us or could be obtained by us which could be employed for drawing up statistics.

REPEATED INHALATION.

Whether the fact of a person having once taken chloroform safely makes it probable that he will take it again with impunity was also considered. Of the cases examined 11 males who died under chloroform had taken it safely once before; 11 females and 13 males more than once, 1 having taken it eight times. It is highly probable that many of the persons who died under chloroform had taken that anæsthetic before and that no note was taken of that circumstance. The importance of this question is evident when it is remembered that it is asserted, upon the one hand, that if chloroform kills through any structural change in the heart due to inherent heart weakness the patient should have succumbed on the first administration; whilst, upon the other, certain observers have believed that chloroform, if given repeatedly, may induce fatty changes in the tissues akin to, although less marked than, the mineral poisons.

RESUSCITATION OF PERSONS APPARENTLY DEAD FROM CHLOROFORM.

In the subjoined table particulars are given of the measures adopted with a view to restore patients apparently dead from the influence of chloroform. The main efforts were almost uniformly directed to the restoration of circulation and the re-establishment of respiration; but a review of the cases reveals the fact that the classes of cases, although presenting very varying symptoms, were treated upon similar, if not uniform, lines. Where all measures failed to resuscitate, no one method can be accepted as having been of more use than another. We shall return to this question when dealing with the treatment of the "untoward cases."

METHODS OF RESUSCITATION EMPLOYED IN FATAL CASES. DEATH UNDER CHLOROFORM.

ARTIFICIAL RESPIRATION:

In Series A the Royal Medical and Chirurgical Society's Report:—

	Cases.
No specific method named	34
By compression of ribs	1
" " chest	2
Silvester's method	1

In Series B collected by THE LANCET from printed and published records:—

No specific method named	147
Bain's method	1
Marshall Hall's method	12
Sayre's method	1
Silvester's method	28
Chaussier's tube used	1
Catheter passed through glottis and air forced through it	1
Insufflation	1
Inflation	1
" by bellows	2
" mouth to mouth	2
Sound passed into larynx	1

In Series C cases recorded in the hospital books:—

Artificial respiration	3
-------------------------------	---

EXCITATION OF HEART:

Electric battery	23
Galvanism	75
Cautery	1
Faradaic current	14
Stöhrer's battery	1
Method not named	1
Acupuncture... ..	7

	Cases.
Electro-puncture	1
Inversion: complete	18
" partial	5
Shoulders raised on pillow	3
Head lowered, feet raised	8
Head raised	1
Venesection	1

STIMULATION:

Cold to chest	39
Heat: hot sponges, hot iron, hot wood to epigastrium, soles of feet, &c.	6
Friction	14
Slapping with wet towel	20
Stimulants and counter-irritants	2
Hoffman's ether	1
Ammonia to chest and præcordium	10
Turpentine stupes to heart	1
Mustard stupes over heart... ..	1
Ammonia to nostrils	30
Ammonia intravenous injection	2
Brandy hypodermically	6
Atropine hypodermically	1
Ether and brandy hypodermically	1
Ammonia and brandy hypodermically	1
Ether hypodermically	16
Strychnine hypodermically	4
Nitrite of amyl to nostrils	9
Brandy by mouth	1
Brandy by rectum	6
Brandy with water by rectum	1
Whisky poured down throat	1
Brandy and ammonia by rectum	2
Brandy and hot water by rectum... ..	2
Sherry	1
Ice in rectum	1
" Stimulant enema "	3
Champagne passed by tube into stomach	1
Drawing tongue forwards	45
Tracheotomy	12
Three cases are quoted in the Royal Medical and Chirurgical Society's Report as having had restorative measures employed, but these are not specified	3
In the other series no record occurs of any measures of resuscitation having been adopted in	44
While in 107 no particulars as to the measures adopted are given	107
In 240 no mention of any attempted resuscitation is made	240

NATURE OF OPERATION.

In giving the following tabulation of operations which were in progress, or had been performed when the patient died under chloroform, some comment may prove useful. The following operations are arranged in the order in which they stand as giving most deaths.

Extraction of teeth, 56 deaths; reduction of dislocations, 36; excision of joints, 28; operations of bones, 28; amputation of fingers, 21; of leg, 15; for fistula in ano, 20; operations on breast, 12; ablation of globe of eye, 12; for hæmorrhoids, 8; parturition, 7. It would thus appear that, having regard to the fact that, excluding the dental operations, most of these cases occurred in hospital, and the number of deaths bear a direct ratio to the frequency with which the operations are performed. With regard to the 56 cases of tooth extraction, it must be remembered that the little operation is of very great frequency; but, on the other hand, it is far from certain that chloroform is so very often given in such cases. The number recorded in our returns is appallingly high and needs careful attention. All observers have noticed that "shock" is present in tooth extraction to a degree which is out of proportion to the intrinsic gravity of the operation. It is commonly the case that the anæsthesia is incomplete or too transitory when brief operations are in progress, especially in those about the mouth, when it is a little more difficult to maintain complete anæsthesia during the surgical procedure. A further consideration is this. In the records the deaths which occurred as a direct result of "shock" are not mentioned. The 16 cases of "shock" given above were in all cases associated with symptoms which showed that the

chloroform played some part in bringing about the fatal issue. In the case of tooth extraction, however, the shock is present, and yet the cases are recorded, as though due solely to chloroform. It seems highly probable that at least many of these cases the death probably arose as a result of the shock of the operation associated as it was with the action of the chloroform on the lowered vitality of the patient. It is noteworthy also that death occurred in 11 cases of removal of the tongue, cases in which peculiar dangers and difficulties are liable to occur. Among the "untoward cases," or those in which grave danger followed the administration of the anæsthetic, but a fatal event was prevented by resuscitation, three dental cases figure and one tongue case. The posture in most of the dental cases was "sitting up." The mode of death is in 23 cases stated to be due to syncope, and clear evidence in these cases (Series A, 2, 13, 16, 24, 28, 54, 60, 77, 82; Series B, 46, 50, 66, 81, 170, 171, 229, 239, 276, 283, 438, 455, 459, 587) points to the fact that circulatory failure occurred without any initial interference with respiration. In Cases 2 and 13 the fatal result was attributed by Snow to "overdose." On the other hand, incomplete anæsthesia is recorded in case 8 (Series A) and in case 46 (Series B), and imperfect anæsthesia was clearly the cause of death in cases 50, 66, 170, 171, 339, 349, and probably in case 410. These cases must also be added to those cited above as having been instances of syncope. What the true mechanism is of these deaths is still uncertain. It has been believed, and with considerable show of probability, that when a patient is partly under the influence of an anæsthetic the nervous elements of the cord and brain are so affected that the check mechanism usually imposed upon the reflex inhibitory mechanism are in abeyance, or partially so. This being so, a skin or visceral stimulus would during semi-anæsthesia lead to inhibition of the medullary centres presiding over the vital processes and death result. In cases 110, 112, 161, and 162 the recorders were of opinion that the death was directly due to such a conveyance of shock to the nervous centres; while in case 517, in which death occurred before the operation was commenced, fear seems to have brought about a similar fatal result through the central nervous system. In this place it is important to point out that in the above statistics when it is said that death resulted from respiratory paralysis, or cardio-vascular paralysis, what is really meant is that death resulted from either drug or reflex action upon those parts of the central nervous system which regulate the mechanisms of respiration and circulation. Another cause of death, and one which ought not to have occurred, is mentioned in connexion with cases 2, 8, and 273. In the first two the chloroform was given from an ether inhaler, and consequently too much was inhaled, while in the latter the patient, a healthy lad, was sat upright in a chair and given chloroform immediately after a hearty meal. In this case further it appears that no remedial measures were adopted for some fifteen minutes after alarming symptoms manifested themselves.

It is worthy of notice that if we exclude removal of the eyeball none of the operations which are supposed to be of peculiar danger from the point of view of shock are mentioned as having caused deaths in any considerable number of cases. Thus only 7 cases of death during hernia operations are recorded, 1 of goitre, 1 of amputation through the hip, and 6 of amputation through the thigh, 6 of castration, one of removal of the lower jaw, 3 of paracentesis thoracis, and 2 of post-nasal adenoid growths. Operations about the penis and genitals or rectum, although often involving shock, appear seldom to have been associated with deaths under chloroform. These facts make it possible to push the theory of shock too far, for it has also to be borne in mind that in a large number of experiments made upon the lower animals the Hyderabad Commission [see p. 11] found it very difficult to produce shock in these creatures even when the anæsthesia was most incomplete. It is, however, a fact recognised by most observers familiar with such experiments that animals vary very much both in their liability to surgical shock and also in the way in which they gave evidence of such shock. The more highly organised the animal, the greater, as a rule, its susceptibility to shock.

The large number of deaths occurring under chloroform when dislocations were being dealt with may be accounted partly by the frequency of the accident, partly by the fact that the chloroformist not infrequently pushes the chloroform to a dangerous extent—to Snow's fourth stage—in order to relax the restraining muscles, and partly because there is a tendency to give chloroform with less precision

and care when a "casualty" is being seen to than when a formal and dangerous operation is in progress. The chloroformist not infrequently "lends a hand" with dislocations and forsakes the golden rule of giving undivided attention to the chloroforming of his patient. Series A Case 42 the operation was commenced and the patient clearly died from overdose. In 74 the same cause of death appears to have been present.

A very remarkable note appears in some of these cases which is so uniform as to enforce attention, since the cases occurred in very different places at various times. It is to the effect that at the moment of the reduction of the dislocation the pulse stopped, a fatal syncope having occurred. This is stated in the following cases: Series A, Case 85; Series B, Cases 108, 109, 166, 268, 468, 545, and probably occurred in 343. In all these cases sudden death occurred with the symptoms of cardiac inhibition. It would appear as if all were instances of a reflex inhibition during an anæsthesia not profound enough to prevent such conveyance of peripheral stimuli. Case 268 appears to countenance this view. At the moment of reduction of the dislocation the patient is described as having a "slight shudder" and "general tremor," followed by death.

In the following cases an overdose seems to have been given probably, as explained above, to promote muscular relaxation: Series A, Cases 42, 160; Series B, 232, and 254. In the first two cases the overdose appears to have been due to the fact that the patient in struggling took in more chloroform than was intended. It must be borne in mind that the full effect of the chloroform is not evident until some time (measured by seconds or even minutes) after the dangerous symptoms appear. In other words, the chloroform in the lungs becomes absorbed into the blood even after respiration and circulation are hampered, and it often happens, as in Series A, Case 67, and Series B, Case 134, that after the operation is completed the patient who till that moment was to superficial observation all right, becomes suddenly comatose and dies from overdose. Cases 285, 360, 369, 370, 375, and 589 also appear to have been overdosing. It is also noticeable that in by far the greater number of these cases the death is put down to heart failure. In one (Case 160) the coroner's jury went so far as to say that the chloroform appeared to have been given recklessly and without due care. A review of these 36 cases is of great interest and appears to show that there is some especial danger or dangers connected with chloroform given for the purposes of reducing the dislocation. In the list of ether deaths one only occurred during the reduction of dislocation, and that in a subject who was only semi-narcotised and suffered from bronchitis and emphysema. In Case 340 death occurred before the operation was commenced.

Of the 12 cases of abscission of the eyeball very little need be said. In Series A, Case 52, the patient died in the stage of excitement, and before the operation was commenced. In Series B, Cases 264, 271, and 331, the patients died from syncope, but as no mention is made of the stage of the operation, or, indeed, whether it had been commenced, no conclusions can be drawn. In the other cases it is quite impossible to trace any causal relation between the operation and the fatal issue. Much the same applies to the deaths during operations upon the breast. Little if any direct influence of the operation can be traced. In Series A, Case 43 seems to have been due to some mismanagement. The patient was forty minutes inhaling chloroform without any anæsthesia being obtained, and then suddenly became comatose and the heart failed. Case 46 is put down as sudden heart failure, and in Series B, Cases 218, 326, and 346 are ordinary cases, while Case 351 shows clearly that an overdose was given, and no special operation influence occurred in any of them.

More interest, however, in this connexion attaches to the 20 cases of death occurring when operation for the relief of fistula in ano was in progress. In Series A in case 30 the operation was not begun, and in case 80 syncope followed within eight minutes of administration. Series B, Cases 25 and 35 were instances in which death followed upon violent struggling, causing intake of an overdose. Cases 43, 154, 317, and 422 were also instances of overdose, while case 154 is a further example of the deepening of anæsthesia occurring from absorption of chloroform in the lungs even after the inhaler is removed, to which we have referred above. Case 227 is an instance of shock—dilatation of anus—brought about by incomplete anæsthesia. This applies also to cases 311 and 583 (a case of operation for hemorrhoids). In Case 298 we are told that general muscular spasm was present leading to respiratory failure. It must, therefore, appear that there is an especial danger in rectal operations arising from incomplete anæsthesia.

OPERATIONS.

A tabulated list of operations is now appended for the convenience of reference.

NATURE OF OPERATION.	No.	NATURE OF OPERATION.	No.	NATURE OF OPERATION.	No.	NATURE OF OPERATION.	No.
Abdomen—		Dislocations—		Foot operations on	2	Neuralgia, for relief of	4
Abscess of	3	Shoulder	2	Ankle	1	Operation (nature not stated) ..	4
Puncture of liver	2	Elbow	26	Ankle "splinting"	1	" not commenced	40
Section of	1	Thumb	1	Foot, operation on	1	" (probably)	3
Hernia, radical cure for ..	2	Total	29	Avulsion of toe-nail	13	Ovariectomy. See Abdomen.	
Herniotomy	3			Total operations on lower ex-		Naso-pharynx, operations about—	
Taxis for recent	1	Excisions—		tremity	84	Adenoid growths, re-	
Strangulated	1	Shoulder	1	Fistula, for. See Rectum and		removal of tumour in	2
Unclassed	2	Elbow	4	Generative Organs.		nasal region	
Ovariectomy	5	Finger (? joint)	1	Fractures for reduction of un-		Parturition	7
Total	20	Total	6	classified	20	Puerperal convulsions	1
Abscess, opening of	9	Forced movements—		Generative organs—		Plastic operations (not	
Alveolar	1	Arm	1	Abscess of bladder	1	classed)	7
Aspiration of	1	Fingers	1	Castration	6	Pyæmia	1
In neck	1			Catheterisation	8		
Total	12	Fractures—		Circumcision	4	Rectum—	
Amputations. See Extremities,		At elbow	1	For extravasation of urine ..	1	Abscess of	1
operations on.		Injury—		For hydrocele	1	Anus	1
Aneurysm of aorta	1	Elbow, for abscess, about ..	1	Lithotrity	2	" injury to	1
Ankle, operation on. See Ex-		Arm, operations on	1	For paraphimosis	3	" fissure of	1
tremities.		" stump of	1	Penis, operation on	1	Fistula in ano	2
Arm, operations. See Ex-		Hand	4	Penis, amputation of	1	For hemorrhoids	8
tremities.		" thorn in	2	Penis, cauterising	1	For impacted feces	3
Artery, ligation of	5	Contracted fingers	2	Perineal fistula	2	Total	35
Bone, operations on. See also		Thumb	1	Perineal urethrotomy	3		
Excision of joints	23	Stiffness at wrist	1	For phibosis	4	Sores, escharotics to—	
Breast, operations on	12	Total operations on upper ex-	85	Prepuce, removal of	1	Nitric acid to	2
Abscess of	2	LOWER EXTREMITIES.		Sounding	2	Ulcers, nitric acid to	2
Removal of	2	Amputation—		Testicle, operation on	1	Total	4
" for tumour	4	Hip	1	Urethra, operation on	3		
Tumours of	4	Thigh	6	Urethra, for tumour of	1	Thoracentesis—	
Total	24	Through knee	2	Urethra, stricture of	3	For pleuritic effusion	2
Bronchocele, for	1	Leg	15	Urethrotomy	2	Pyothorax	1
Operations on bursæ	1	Foot	4	Vesico-vaginal fistula	1		
Cautery, use of	2	Toes	8	Total	52	Thorax—	
Cheek, epithelioma of	1	Total	36	Hand, injury to. See Ex-		Caries of rib	1
" sarcoma of ace	1	Dislocation—		tremities.		Total of operations on	4
Dislocations for reduction of	36	Hip	3	Harelip, operation for. See		thorax	
Erysipelas, incisions for ..	3	* Thigh (? Hip)	1	Jaws and Mouth.		Tracheotomy	5
Examination under chloroform	1	* Leg	1	Hernia. See Abdomen.		Tumours—	
Excision of joints	9	(* Sic)	1	Jaws and operation about		Unclassed	9
Extraction of thorn	1	Total	5	mouth—		Aspiration	1
Total	56	Excisions—		Cleft palate	1	Axilla	1
Eye—		Hip	1	Epulis	3	Breast	4
Operations on (not specified)	5	Knee	1	Epithelioma of lip	1	(?) Cancer	4
Ablation of globe	12	Ankle	1	Tumour of lip	1	(?) Cyst	1
" cyst	3	Total	3	Enchondroma of lip	1	Glands	1
For cataract	2	Forced movements—		Fracture of	2	Of lip	1
" entropion	2	Knee	5	Harelip	4	Lipoma	2
" glaucoma	2	Leg	1	Tumours of	2	Nasal region	1
" iridectomy	6	Total	6	Lower jaw, removal of	1	Neck	4
" ophthalmia	1	Fractures at—		Teeth, extraction of	56	Sterno-mastoid	1
" strabismus	8	Hip	1	Lupoid growth on lip	1	Throat	2
Total	40	Thigh	3	Tumour of lip	1	Urethra	1
UPPER EXTREMITIES.		Patella	1	Tongue, removal of	11	Total	33
Amputation—		Leg	7	" and part of jaw	1		
Shoulder	0	Ankle	2	" mouth " " floor of	1	Uterus—	
Arm	3	Total	14	Total	87	Fissure of cervix	1
Forearm	1	Hip, exploration of	1	Joints. See Extremities.		Prolapse	1
Hand	4	Leg "splinting"	1	Examination of	2	Tumour of	1
Thumb	5			Forcible movement of	9	Polypi, removal of	1
Fingers	21			Malformation, remedy of ..	1	Total	4
Total	34			Mania, to quiet in	2	Wounds—	
				Delirium tremens, to quiet in	4	Dressing	1
						Sphacelated	2
						Total	3

RESULTS OF NECROPSIES.

A careful consideration of the large number of records placed before us of post-mortem examination of persons dying under chloroform showed that it would be possible to group all the salient points of such reports under a few headings. For this purpose the following were found the most suitable :—(1) Heart and arteries and circulatory system in general; (2) the lungs and air passages; (3) the brain and central nervous system; (4) the kidneys and (5) the blood.

RESULTS OF POST-MORTEM EXAMINATIONS.

Heart, arteries &c.	Lungs and air-passages.	Brain.	Kidneys.	Blood.
"Cardiac disease."	Congestion of lungs.	—	—	—
Heart fatty.	Lungs congested; apoplectic clot; oedematous.	—	—	—
Heart large, flabby, soft; ventricular wall thin; right-sided distension.	Lungs engorged.	—	—	Fluid.
—	Laryngeal tissues infiltrated.	—	—	—
—	Lungs tubercular, engorged.	—	—	—
Right cavity full of blood fluid.	—	—	Left, pyelo- nephritis.	—
Fatty, wall thin, degenerated.	—	—	—	Fluid.
Enlarged, fatty.	—	Congested.	Congested.	Fluid.
Flabby, fatty.	Lungs collapsed, congested.	—	—	—
Extensively diseased.	Lungs extensively diseased.	—	—	—
Fatty degeneration.	—	—	—	—
Fatty.	—	—	—	—
Fatty.	Lungs "unhealthy."	—	—	—
Fatty, flabby.	—	—	—	—
Fatty.	—	—	—	—
Fatty, flabby, deformed; left ventricle hypertrophied.	Lungs small, gorged with blood, displaced upward by pressure and large liver.	—	—	—
Fatty degeneration.	—	—	—	—
—	Lungs congested.	—	—	—
Slight hypertrophy of left ventricle.	—	—	—	—
Fatty.	—	—	—	—
Right distended with blood.	Lungs congested.	—	—	—
Fatty	—	Effusion between dura and pia mater and between the latter and arachnoid.	Congested, degenerated.	—
Fatty.	Lungs hypothetically congested.	—	Fatty.	—
Fatty degeneration.	Lungs congested.	Effusion of blood on dura	Congested.	—
—	—	Pia mater congested.	—	Fluid.
Fatty, degenerated (fatty degeneration).	—	Tubercle at base of brain	—	—
Right ventricle soft, flaccid; left contracted.	Lungs congested.	—	—	—
"Very diseased."	—	—	—	—
"Diseased."	—	—	—	—
—	—	—	—	—
Enlarged (slight).	—	Venous congestion.	—	—
Enlarged, thin walls.	—	Dura adherent, pia mater and arachnoid opaque.	—	—
Fatty.	—	—	—	—
"Diseased."	—	—	—	—
Enlarged, flabby.	Lungs emphysematous.	—	—	—
Very fatty.	—	—	—	—
Fatty degeneration; valvular disease.	Lungs congested.	—	Congested.	—
Enlarged, hypertrophied, granular degeneration.	Lungs full of frothy fluid.	—	—	—
Right side enormously distended; fatty degeneration.	—	—	—	Fluid.
Valvular disease; loaded with fat; also degeneration.	—	—	Albuminoid.	—
Fatty; valves diseased.	Lungs congested.	—	—	—
Fatty degeneration.	—	—	—	—
Flabby, fatty.	—	—	—	—
Fatty degeneration.	Lungs, patches of collapse.	—	—	—
—	Lungs adherent, emphysema, lobular collapse.	—	—	—
Fatty.	—	—	—	—
Slightly flaccid, fatty.	—	—	Fatty.	Thin and frothy.
Dilated.	—	Softened.	Fatty.	—
Right ventricle containing a notable quantity of air.	—	—	—	—
Fatty, dilated.	Engorged lungs.	—	—	—
Valvular disease of mitral and aortic.	—	—	—	—
Hypertrophied and fatty.	—	—	—	—
Hypertrophied and fatty.	Lungs emphysematous.	—	—	—
Degeneration.	—	—	—	—

RESULTS OF POST-MORTEM EXAMINATIONS *continued.*

Heart, arteries &c	Lungs and air-passages.	Brain.	Kidneys.	Blood.
"Diseased."	Diseased.	—	—	—
"Diseased."	"Diseased."	—	—	—
Fatty, dilated; coronary artery atheromatous.	Lungs adherent, emphysematous.	—	—	—
Engorged with blood.	Lungs tubercular.	—	—	—
Arteries atheromatous.	Lungs congested.	—	—	—
Enlarged, flabby.	Lungs infarcted.	—	—	—
Fatty.	Lungs congested.	—	—	—
Right heart distended with blood; heart poorly nourished.	—	—	—	—
Loaded with fat; walls thin; aorta dilated; arteries atheromatous.	—	—	—	—
Very flabby and fatty (fatty degeneration).	—	—	—	Black.
—	—	—	—	Black and fluid.
"Diseased."	Lungs "diseased."	—	—	—
Lax and collapsed.	Lungs, adhesions.	—	—	—
Fatty; aorta atheromatous.	—	—	Granular disease.	—
Enlarged.	—	—	—	—
"? other disease."	—	—	—	—
"Certain disease" (?)	—	—	—	—
—	Lung; pleuritic adhesions; abscess in right lung; partial consolidation of bases.	—	—	—
Flabby.	—	—	—	—
Fatty, degenerated.	Lungs congested.	Congested.	Granular.	—
Fatty degeneration	—	—	—	—
Dilated and hypertrophied.	Lungs congested.	Congested.	—	—
Fatty degeneration.	Bronchocele involving left lobe of thyroid.	—	—	—
Aneurysm of aorta.	Larynx flattened and dilated; wounded.	—	—	—
Fatty degeneration.	—	—	—	—
—	—	Effusion of blood.	—	—
Heart dilated; fatty.	Lungs congested.	—	—	—
Fatty degeneration.	—	—	—	—
Hypertrophied.	—	—	—	—
Fatty degeneration.	—	—	—	—
Commencing fatty change.	Lungs emphysematous.	Congested.	Congested.	—
Fatty.	—	—	—	—
Fatty degeneration.	Lungs congested.	—	—	—
—	"Lungs never properly inflated."	—	—	—
Bubbles of air said to have been found in vessels of heart.	Bubbles of air said to have been found in vessels of lungs.	Bubbles of air said to have been found in the vessels of brain	—	—
Extensive adhesions of pericardium.	—	—	—	—
—	Lungs congested; hepatised.	—	—	—
—	—	—	—	—
Enlarged, fatty.	Lungs emphysematous.	—	—	—
Hypertrophied.	Extreme emphysema.	—	Congested.	—
Fatty degeneration.	—	—	—	—
Fatty.	Lungs cedematous.	—	Granular.	—
—	—	Arachnoid very opaque; large effusion of blood.	—	—
Flabby.	—	—	—	—
"Heart disease."	—	—	—	—
Flabby.	—	—	—	—
Fatty change.	Fibroid lungs.	—	—	—
Fatty degeneration.	—	—	—	—
—	Tumour of thyroid pressing on trachea.	—	—	—
—	"Pseudo-membranous pleurisy."	—	—	—
—	Lungs congested.	—	—	—
Fatty degeneration.	—	—	—	—
"Exceedingly fatty."	—	—	—	—
Large, flabby; atheroma of coronary arteries.	—	—	—	—
Fatty degeneration.	—	—	—	—
Fatty degeneration.	—	—	—	—

RESULTS OF POST-MORTEM EXAMINATIONS—*continued.*

Heart, arteries &c.	Lungs and air-passages.	Brain.	Kidneys.	Blood.
—	Larynx injured; blood in trachea.	—	—	—
"Cardiac disease."	—	—	—	—
"Had disease of heart."	—	—	"Had disease of kidneys."	—
"Heart disease."	"Old disease of ribs and pleura."	—	—	—
Fatty degeneration.	—	—	—	—
Overlaid with fat.	—	—	—	—
Fatty embolism.	—	—	—	—
—	Food in trachea.	—	—	—
Malformed.	—	—	—	—
Dilated.	—	—	Granular.	—
Fatty infiltration; coronary arteries atheromatous.	Lungs congested, cedematous.	—	—	—
Enlarged.	—	—	—	—
Aneurysm of innominate.	—	—	—	—
—	Tubercular lungs.	—	—	—
—	Chronic pneumonia.	—	Gunma in kidneys.	—
Fatty degeneration.	—	—	—	—
Fatty degeneration.	—	—	—	—
Fatty degeneration.	—	—	—	—
Fatty heart.	—	—	—	—
Fatty heart; aorta sacculated.	Emphysematous lungs.	—	—	—
"Edema of pericardium"; slight mitral disease.	—	—	—	—
Flabby, thin.	—	—	—	—
—	Lungs emphysematous.	—	—	—
—	Malignant growth in back of pharynx impeding respiration.	—	—	—
Fatty degeneration.	—	—	—	—
Fatty degeneration.	—	—	—	—
Right heart dilated.	—	—	—	—
Very flabby.	—	—	—	—
—	Adherent pleura.	—	—	—
Malformed.	—	—	"Extensive kidney disease."	—
Fatty degeneration.	—	—	Fatty degeneration.	—
Fatty degeneration.	—	—	—	—
Fatty.	—	—	—	—
Fatty degeneration.	—	—	—	—
—	"Disease of lungs."	—	—	—
Thin.	Lungs tubercular.	—	—	—
Fatty degeneration.	—	—	—	—
—	—	—	—	Leukæmia.
—	Adherent pleura.	—	—	—
Advanced fatty infiltration.	Right empyema; lower part of lungs gangrenous.	—	—	—
Overlaid with fat.	Lungs emphysematous.	—	—	—
Dilated, thin walls.	—	—	—	—
Flabby, fatty.	—	—	Granular.	—
Fatty; left ventricle dilated.	—	—	—	—
—	Lungs, double pleurisy.	—	—	—
Mitral and aortic incompetency.	—	—	Cystic.	—
Fatty.	Lungs congested, cedematous, bronchitic.	—	Fatty.	—
Thin walls, fatty.	—	—	—	—

The actual cases of death under chloroform are given below, and the statistics already given, and those which follow are taken entirely from these records. The cases are those in which death has occurred when chloroform was being administered and when the death was apparently due to the direct influence of the drug and was so regarded by those who reported the occurrence. It has been thought advisable to divide these cases into three Series. In the first series (Series A) the deaths include those which occurred between the years 1848 and 1860. This series corresponds with the record of fatalities reported by the Special Committee of the Royal Medical Chirurgical Society, published in vol. xxix. of the Second Series of their Transactions in 1864 (p. 323 *et seq.*). It was, however, found necessary, in order to render this series more complete, to examine the journals and other published records of cases and to collate the facts so obtained with those furnished by the Royal Medical and Chirurgical Society's Transactions. Special assistance was obtained by the examination of Dr. Snow's volume, which, besides giving very full records of cases, furnished incisive criticisms and comments which suggested a further search for information. In this first series of cases, which we have described as based upon the list drawn up by the committee of the Royal Medical and Chirurgical Society, many fresh cases appear, so that our list must not be taken as a mere excerptum of the Transactions of that Society. In the cases which appear in the Transactions many salient facts were not given in the very condensed accounts which the Society published, and these we have been able in some instances to supplement from journals or other published records, thus presenting the cases in a more complete form. The second (Series B) comprises the record of cases obtained from published accounts of fatalities which occurred between 1860 and 1891. The sources of information for these were the current medical literature and records afforded us in the shape of answers sent in to us in reply to our circular by medical practitioners both in the United Kingdom and abroad. The utmost attention has been paid to tabulating the records, and in most instances several accounts of each fatality have been consulted and the essential particulars taken from them so as to form as full and connected a narrative as possible. The amount of information to be obtained varies very considerably, it being full to redundancy in some instances, but most meagre in others. It has, however, been thought advisable to maintain the sequence by inserting the cases even when only the mere fact of the death has been notified. In the instances in which the deaths were reported to us by practitioners we have regarded the communication as a private one, in accordance with the terms of our forms, and have omitted from our published report the name of the patient and that of the medical man. In the third series (Series C) are included—(1) the cases of fatalities which had occurred in Hospital practice under chloroform, reported on the larger form sent out with THE LANCET inquiry; and (2) similar cases supplied by medical men on the smaller form.

The first column in the tabular abstracts of cases contains a number which refers to the original lists, thus affording a means of substantiating the authenticity of the record. The first series comprises 86 cases, the second series 596, and the third 34. The headings "Age" in the second and "Sex" in the third column need no special comment.

In the fourth column the nature of the operation and the duration of the period of administration of the chloroform are given. We have already pointed out the importance of affording due consideration to possible factors in determining a fatal result to chloroformisation, instancing the assumed danger of some operations when of a nature to give rise especially to shock. The importance of considering the duration of the narcosis is evident when we remember that cooling of the patient's body, after-effects such as sickness, the phenomena which many authorities, grouping together under the term "shock," believed to be the direct result of the action of the anæsthetic, are proportional to the time the patient is exposed to the influence of the chloroform. The duration is taken as representing the period of time between the commencement of the inhalation until the death of the patient, or, perhaps more correctly, until the commencement of measures adopted with a view of resuscitating the patient.

We have been unable to append a column containing the name of the administrator, and this omission, grave as it may appear, is due to the fact that in a very large number of instances no mention at all is made of the actual administrator or of the experience he may have had in administering

the drug. In some cases where mention is made of the person giving the chloroform we find that he was not a medical man at all; thus, in one instance the master of a workhouse is described as having officiated. In several other cases dentists not holding medical diplomas are reported as having given their patients chloroform. We hope to allude to these cases subsequently. A careful examination of them is peculiarly instructive, as they appear to support the view which some observers have advanced that there is an especial danger of fatalities occurring when the patients are only partially under the influence of chloroform. Again, it is noted in most, if not all, of these cases that the patient was placed in a sitting posture in a dentist's chair—a position which some hold to be peculiarly unsuitable to the safe exhibition of chloroform. Many instances occurred in which, whilst comparatively trifling operations were being performed, a fatal accident occurred: and in these, again, we find mention made, or the narrative seems to suggest, that the amount of chloroform inhaled was small—probably quite insufficient to ensure complete anæsthesia. The possible occurrence of shock under these conditions requires to be considered. In one case a medical man, previously to a very minor operation, held the towel saturated with chloroform over his face with his own hands—a proceeding, we need hardly say, fraught with the utmost danger, especially as in this instance it was found that the stomach was distended with undigested food. A fact worthy of notice is that in comparatively few cases, unless occurring within the precincts of a hospital, is any mention made of a second medical man having been present to assist in the administration of the anæsthetic or the performance of the operation. This omission no doubt in some instances is due to force of circumstance, but can hardly be so in all. It would indeed seem as if in some of the cases but few, if any, precautions or preparations were made before the chloroform was administered. It certainly would appear that a proportion of these deaths was preventable—that is, in the sense that various obvious dangers were not avoided and that various conditions tending to enhance the danger incurred were overlooked or ignored. Amongst the most conspicuous are posture, to which we have referred above, in dealing with the dental cases and the above-cited instance with others of food given just before the use of the anæsthetic. Yet another reflection occurs when we deal with the chemical purity of the chloroform employed. In some instances actual published statements appeared asserting that the chloroform employed was impure and had undergone partial decomposition, giving rise to cough, dyspnoea, and finally to suffocation. It is well known that such changes pretty rapidly develop when chloroform is exposed to diffused daylight, especially if kept in a warm room. It is probable that most or all of the chloroform sold by the wholesale makers is sufficiently pure to be free from deleterious matter, and that whatever impurity does appear does so after the chloroform has passed into the hands of the person who administers it.

The next column is occupied with information concerning the nature of the anæsthetic and the method of employing it. Here we regret to have to draw attention to the loose way in which the "method" employed has been, as a rule, described. A detailed and exact definition of the method employed in every case of death under chloroform would probably lead to valuable criticism from those constantly engaged in the use of anæsthetics, and errors or slight inaccuracies of technique might be pointed out which would possibly save a repetition of errors sometimes immediately responsible for the fatality.

In the sixth column the question of pulse (P.) and respiration (R.) is considered with regard to which failed first. Thus, when the reports furnished to us state that the respiration failed before the pulse, this is notified in the column by the letter R. When the pulse is said to have ceased before respiration it is represented by P., whilst when respiration and pulse are reported as stopping simultaneously it is explained by the sign R. and P. When doubt existed as to which failed first a note of interrogation is used or placed before the letter P. or R., according as the Report said "probably" the pulse or the respiration failed first. Full allowance has been made for the difficulty of obtaining accurate information on this point, in the excitement of an impending death under chloroform, but the large number of cases examined possibly helps to eliminate errors of observation. Again, the liability to error most likely tells as much against one set of observations as against the other.

In the column (7) dealing with the symptoms occurring under the anæsthetic as full but succinct an account of the whole case is given as the material at hand permitted.

This column, when considered in conjunction with Column 6, shows that in a large proportion of cases some note—at times fairly full—was kept of the state of respiration and of the pulse. It would seem from these records that it is a common practice amongst surgeons to devote attention to both systems and to adopt resuscitative measures promptly on the appearance of asphyxial phenomena. In many of the cases it will be noted that mention is made of a renewal of the inhalation, but this is not sufficiently specifically stated for us to do more than draw attention to what may be a clue towards finding an explanation of some of the deaths. We shall return both to this point and to the question of the observation of respiration when we consider the cases which we have classed as “untoward cases.”

In the eighth column the assigned cause of death is recorded and an attempt made to inquire into the indirect or adjuvant causes. In this column, also, is included a very brief account of the post-mortem appearances when a necropsy took place and was reported to us. Although these notes are very short it is believed that they include all the salient points.

A point of great interest occurs in connexion with the evidence afforded by the post-mortem examinations. We gave above descriptions of necropsies in a tabular form, and in the lists which we are now reviewing fuller particulars are presented in Column 8. Unfortunately, the examinations are of little value as a guide to what changes, if any, are actually brought about by the chloroform itself, because in by far the majority of instances they were not made until twenty-four hours or even longer after decease. They, however, emphasise the frequency of the association of certain lesions with fatalities under chloroform. In comparing Columns 8 and 9 discrepancies will be detected in that, whilst the examination of the patient's respiratory and circulatory organs during life and before chloroform was given went to show that the patient was organically sound, the necropsy told another tale. There is no doubt that if a preliminary physical examination of a patient is made—and as to the advisability of this step it is beside our present purpose to inquire—it should be carried out as thoroughly and minutely as would be done were the individual to submit himself for a diagnosis upon some malady from which he was suffering. In not a few cases, when the patient was described as “healthy,” further inquiry elicited the fact that organic disease existed, but the general appearance of the patient was healthy.

In the ninth column, under the heading of “Remarks,” are included facts which bear upon the general state of health of the patient at the time of the administration which might indicate a predisposing cause for his death under the anæsthetic. It is not for a moment contended that these records supply sufficient data for complete answers to the problems which the subject presents, but it is hoped that they may assist in obtaining a more thorough and intimate knowledge of the subject. When the full records have been published, and the other anæsthetics have been considered in a similar way, it is proposed to offer some further remarks in which the various agents employed in producing anæsthesia and their effects will be compared.

It is evidently impossible to review these cases except under various general heads. One of the most important is to ascertain during what stage of anæsthesia most deaths occur. Chloroformisation is conveniently divided into various stages, each of which presents phenomena peculiar to itself. Dr. Snow employed a useful classification of these stages or “degrees” of narcotism under chloroform, which will be adhered to as a matter of convenience in dealing with the ways in which death appears to occur. The first degree covers the period between the commencement of inhalation and the impairment of common sensibility. During the second degree there are mental confusion and violent struggling, sensation to pain being blunted. In the third degree there are loss of voluntary movements, muscular rigidity, muscular spasms, and the reflexes are in abeyance, and at its close relaxation of the muscles—the stage of surgical anæsthesia. In the fourth degree stertorous breathing, dilatation of pupils, and complete muscular relaxation are met with. The fifth degree extends from respiratory embarrassment to total cessation of respiration, and death through paralysis of the medullary centre.

Deaths in Narcosis of First Degree.—Illustrations of this may be found in various cases under Series A. For instance, in Case 28 the patient, after four or five inspirations, answered a question and suddenly died. It appears from this and similar cases that death occurring in this degree of narcosis is the result of heart failure; but it is difficult to be certain whether the heart failure is merely in coincidental or in causal relation with the chloroform inhalation. Case 59: “Gasping respiration” is recorded—a peculiar danger of this and the second degree. The irregular intake of the vapour which occurs in gasping respiration, associated as it is with imperfect expiration, is peculiarly liable to lead to an overdose. The convulsive movements point, with the other symptoms, to an overdose. Case 60: An instance of the “shot-down” form of death,* which would appear to result from the sudden intake of a dose which for the particular individual proved lethal. Case 73 and many others, which will readily be seen by studying the abstracts, exemplify the common mode of death in this degree of narcosis. When dealing with the other anæsthetics, especially with ether, it will be seen that these deaths, which take place at the very commencement of inhalation and which are assigned by some persons as examples of “death from fright,” are practically only met with when chloroform or an agent which possesses similar properties is used. If this be true, and the evidence of the report before us seems to substantiate it, it would point to the fact that some agent other than “fear” is accountable for such deaths. Upon the other hand, a few cases of death from fright upon the operating table are on record when there was no question of chloroform or any other anæsthetic having been employed. Series A, Case 77 appears to be a further instance of cardiac failure.

Deaths in Narcosis of Second Degree.—Series A, Case 11. The stage of struggling which occurs as the patient passes from the second into the third degree of narcosis is one of peculiar danger, as all violent muscular efforts are marked by irregular respirations, frequently with powerful inbreaths of air, which if chloroform vapour in any degree of potency is inhaled may readily lead to an overdose. A moment's consideration will show that under these circumstances a vapour well within the 5 per cent. strength of safety (Clover) may, by the patient taking a breath of double the ordinary depth, become a lethal dose, the more so if, as is commonly the case, the chloroformed air be incarcerated by the expiration being delayed whilst fresh muscular efforts are being made. In Case 11 of Series A the patient “struggled for a moment” and finally died “in the stage of excitement.” In Case 33 the patient died during the stage of excitement. In Case 34 death followed “a long inspiration.” In Case 56 the patient, by “the long, deep breath,” took in a lethal dose. Had the usual rate of respiration been maintained the dose inhaled might have been well within the safe zone. Case 61 affords a further instance of the perils of a prolonged period of muscular excitement causing overdose and collapse. The respirations are in this condition both prolonged and deeper than normal. In Series B, Cases 25, 35, 232, 254, 282, and 298 are similar, death evidently following an excessive dose taken while the patient was struggling. In this last case possibly some muscular spasm may have increased the danger by fixing the thoracic muscles. See also Case 71 in this series.

Deaths in Narcosis of Third Degree.—During the third degree, or that adopted for surgical procedure, deaths are commonly reported as occurring apparently from failure of respiration or from failure of the heart's action. It is important to note that although by some it is asserted that all cases are really due to respiratory paralysis; yet, on the other hand, we find careful records sent us of fatalities which the reporters believe were solely due to cardiac failure. In Case 67, Series A, an initial period of excitement was controlled by more chloroform. The respiration and pulse remained regular and the operation was completed. On removal of chloroform, whilst remarks were being made on the case, the pulse stopped, but respiration continued. This illustrates a case of apparent heart failure. Case 70 was also assigned as one of syncope. As has been pointed out above, other forms of heart failure appear to occur. These are, for lack of a better

* See Proceedings of Royal Medico Chirurgical Society for July 3rd, 1895, in which the death from Chloroform is referred to as being similar in mechanism to that resulting from gun-shot wounds of the brain.

name, termed "reflex" in this Report, and several of them have been already instanced as having occurred during rectal operations and the reduction of dislocations.

Deaths in Narcosis of Fourth Degree.—In Series A, Case 50, the stertorous breathing marked the passage from the safe to the dangerous degree of narcotism. The breathing was restored by artificial respiration; but the patient shortly relapsed into feeble respirations, which finally ceased. This is a common enough history and seems to point to a graver state of affairs than the mere temporary poisoning of the respiratory centre in the medulla by the chloroform in the blood stream. (Series B 203, similar case.)

Deaths in Narcosis of Fifth Degree.—Case 74. The delimiting line between the fourth and fifth degrees of narcosis is one not easily recognised in all instances. It is usual to push chloroform to the fourth degree for reduction of dislocations or other surgical procedures when complete muscular relaxation is required. As a result of this practice we have a large number of deaths where this particular procedure was being done clearly giving rise to overdose, the patient passing into the fifth stage and never recovering. In every instance the warning stertor is not present, especially if the chin be held up,¹ and then the medullary centre may become poisoned, and, as in this case, the respiration fails—an event followed more or less immediately by cessation of the heart's action and ghastly pallor. The failure of respiration in these cases is gradual and death is due to overdose or interference with the elimination of the drug. The above appears to represent the usually accepted opinion upon this point and expresses Dr. Snow's views.

Modes of Death under Chloroform.—Various ways in which patients die when poisoned by chloroform are well exemplified in the tabulated cases before us. 1. In the first degree (*vide supra*) patients die suddenly as if shot, respiration and cardiac action ceasing simultaneously and suddenly; compare Series A, Cases 23, 28, and Series B, Cases 9, 32, 34, 63, 64, 95, 104, 116, 122, 126, 153, 158 (noticeable, as it is expressly mentioned that no respiratory difficulty was in evidence), 187, 253, 275, and others. 2. Death supervening suddenly, just as the operation was commenced; this has occurred many times in dental operations attempted under chloroform, also in reductions of dislocations. It occurs when the patient is supposed to be in the third degree of narcotism, but it is probable that that stage in many of these cases was never reached; cf. Series A, Cases 27, 41, 65, and 72; and Series B, Cases 57, 75, 108, 110, 112, 166, 239, 242, and others. In discussing this subject when dealing with the deaths which took place when the dislocations were being reduced it was shown that the mechanism of such fatalities is probably of the nature of a "reflex," and arises from peripheral stimuli being conveyed along nerve channels which, had the patient been completely under the influence of the anæsthetic, would have been closed as far as the production of reflex inhibitions are concerned. 3. Death during the stage of excitement and struggling; cf. Series A, Cases 11, 17, 19, 34, and 61; and Series B, Cases 19, 25, 195, 199, 244, 247, and 262, is referred to above under Deaths during the Second Stage of Anæsthesia. 4. Spasm of respiratory apparatus occurs in many cases, such as Series B, Cases 39—in which the muscles concerned in respiration passed into spasm and the patient died from asphyxia—299, 347, 398, and others. This may occur from laryngeal spasm due to irritation of pure chloroform or an impurity in it. Case 39, Series B, should be compared with Series A, Case 62. 5. The occurrence of vomiting, even when it does not lead to sucking in of the vomit into the air passages, as in Series B, Cases 73 and 188, seems in many cases to have coincided with the instant of death. It may of course be a phenomenon of dissolution just as ejection of the fæces and urination often are, but upon the other hand it is to be remarked that when vomiting comes on in cases where no fatal result occurs there is a marked deterioration of the pulse and fall of blood-pressure. 6. Sudden death occurred just as "fresh chloroform was given," no doubt due to an overdose being taken in; cf. Series B, Case 28, as a typical instance of this. Many cases—e.g., Series B, Cases 28, 234, and 296—are recorded when during the operation the patient

showed signs of returning consciousness, in some instances even sitting up, and the anæsthetist at once reapplied the chloroform. The death which ensued is no doubt due either to overdose or reflex shock. Case 75, Series A, illustrates another cause tending to fatalities under chloroform. Self-administration of chloroform, of which more than one instance is before us, means grave danger and often death. No words can be too strong in speaking in reprobation of this terrible habit.

Among the causes of death, we would say of *preventable* death, shown only too plainly in the records, is the employment of chloroform by persons either quite unfamiliar with its dangers and the necessary precautions to be adopted to avoid these or only partly versed in its use. Many cases of dentists who held no medical qualification and of persons wholly untrained in medical and surgical work are recorded as having given the chloroform, and therefore been largely or wholly responsible for the fatal result.

Another class occurs during "incomplete anæsthesia"—that is, before the patient has passed beyond what Dr. Snow termed the "second degree of narcosis." In Series A, Case 1 (the sitting posture), the distension of the stomach with food and dread of the operation seem to have contributed to the fatal result; whilst the very painful nature of the operation—avulsion of the nail—during incomplete anæsthesia probably induced the attack of syncope (Snow) to which the patient succumbed. In Series A, Case 3, incomplete anæsthesia was noticed, the operation being commenced before true narcosis was arrived at, and the attempt to force the chloroform led to "overdose." Case 4 is another instance of "incomplete anæsthesia." Case 5, a further instance of this, is interesting as having occurred at Hyderabad (1848). In Case 30 fresh chloroform is reported to have caused "spluttering," an expression which would appear to indicate that the strength of the vapour employed set up considerable interference with respiration, leaving no doubt as to an overdose. In these cases it is important to remember that an "overdose" may be taken in any of the degrees of narcosis and may kill at once. Thus in the first degree the sudden intake of too concentrated a vapour will determine sudden death, probably by immediate poisoning of the medullary centres. The responsibility incurred by the operator in permitting chloroform to be given to his patient is greatly influenced by the circumstances of the case. In one instance the patient (a medical man) was permitted to hold the towel saturated with chloroform over his own face and a fatality resulted. The symptoms described (Series B, Case 1) point to an overdose. In another instance (Case 13) the patient, who was a medical man, is again mentioned as having given himself the chloroform; he was seated in a chair and displayed "great agitation as soon as the tooth was extracted." In the instance already cited the master of a workhouse appears to have given chloroform. In Series A, Case 2, the persons giving the chloroform appear to have been dentists who did not possess a medical diploma and who do not seem to have had adequate knowledge of the agent they were using, as even upon the onset of alarming symptoms they kept the patient in the sitting posture, and, further, they attempted to use an ether inhaler in the employment of chloroform—ignoring the fact that the two anæsthetics, chloroform and ether, should be administered according to totally different principles and by most diverse methods. There can be no doubt that unqualified persons are legally guilty of manslaughter if they give chloroform and the patient dies. No "covering" by a medical man who is present could shirk the responsibility from the person who actually administers the chloroform.

Case 63. The patient's mother was given the chloroformed handkerchief to hold whilst the operator commenced his examination of the foot. There can be little doubt that to relegate such a duty to unskilled persons, especially to those who would certainly watch the operation rather than the patient's respiration, is increasing the risk to the patient and assuming the responsibility of the fatality so liable to happen under such circumstances.

Case 64. The chloroform was administered by a druggist with a view to tooth extraction.

Case 75. A child is reported to have held the cloth from which the chloroform was inhaled. The patient was in the habit of dosing herself for the relief of neuralgia.

¹ Surgeon-Lieutenant-Colonel Lawrie has drawn attention to the danger of this practice as robbing of a most valuable indication that the chloroform has been pushed far enough.

Re-administration of chloroform during an operation.—It is noticeable that in a number of cases the patient is described

as having either partly resumed consciousness or some symptom is mentioned which seems to justify the suspicion that the third degree was not maintained and that either the second or first was re-entered; then more chloroform was given and the patient suddenly died. Thus in Series A, Case 7, the breathing after being "stertorous" grew feeble and necessitated the employment of artificial respiration with the desired effect of restoring consciousness. Chloroform was then resumed and death at once took place. In this case it seems probable that, besides too strong a dose being given and the patient being carried into the fourth degree of narcosis, he was subjected to an additional and lethal dose when his respiratory centre again began to act. In Series A, Case 28, to avert return to consciousness fresh chloroform was given—presumably a fairly strong dose, as we are told that the patient "held his breath." Snow's inhaler was used in this case, which, if properly managed, is believed to ensure an even and safe evaporation of the chloroform. The danger of breath-holding consists in (a) incarcerating what chloroform is already in the blood, and (b) leading subsequently to an abnormally deep inspiration, with its consequence—viz., increased intake of chloroform.

Series A, Case 86. The reapplication of chloroform appears to have determined the fatal syncope. Several similar cases will be seen in Series A and B, in which a like cause produced a like result.

Miscellaneous Notes.—Series A, Case 13, is an instance of overdose. In Case 35 of the same series respiration is stated to have been maintained for twenty minutes after all evidence of heart movements had been lost. Case 38 may be taken as an example of many cases to be seen in the epitomes before us in which death followed the induction of anaesthesia in a person the subject of strangulated hernia. The death however in this case seems to have been due to respiratory embarrassment arising from overdose taken in during the stage of struggling. The peculiar liability to fatalities under these circumstances appears to obtain alike under all anaesthetics. It would carry us beyond our present purpose to discuss whether these deaths were due primarily to the anaesthetic, or to the

enfeebled state of the patient, or to the involvement of the large sympathetic plexuses of the abdominal cavity; but one thing is certain, that no class of cases is subject to graver risk under anaesthetics than is that under discussion. See also Series B 73; 236; 288; 296; 373, &c.

Series A, Case 43. Inhalation of chloroform for forty minutes without producing complete narcosis certainly reveals a faulty method. The extreme slowness, as the extreme rapidity, of induction of unconsciousness is not free from danger. In the former case the stage of struggling and excitement is greatly prolonged, and, besides exhausting the patient, has the danger of forced inbreaths of chloroform referred to under the heading, "Deaths in narcosis of the second degree."

Case 54 is extremely curious, as the patient is distinctly stated to have resumed consciousness before death. The death was probably purely syncopal.

Case 58 illustrates the danger of leaving the patient unwatched as he is resuming consciousness. The passage from a higher to a lower degree of narcotism is commonly associated with a diminution of blood pressure, a weakening of the pulse and a tendency to vomit, and the utmost vigilance should be displayed in the case of persons recovering consciousness to guard against these dangers.

Case 62. The chloroform employed in this case was said to have been of a very irritating nature, from the development in it of impurities. There can be no question that the presence of hydrochloric acid, free chlorine, and other gross impurities increases the danger of the employment of the drug. It is, however, stated by manufacturers of repute that properly protected chloroform will remain pure, except for a small and unimportant quantity of alcohol, for an indefinite time. This will not be the case if air has access to it. The death in the case under review appears to have been the result of spasm of the larynx.

Case 84 is an instance, of which others may be noticed, in which even if the chloroform was the determining cause of death there were many adjuvant causes so powerful in their effects as to make it doubtful whether they, rather than the chloroform, were not responsible for the fatal termination of the case.

ABSTRACTS

OF

FATAL CASES UNDER CHLOROFORM.

SERIES A.—ROYAL MEDICAL CHIRURGICAL CASES, 1848 TO 1860.

SERIES B.—CASES, 1860 TO 1891. PUBLISHED RECORDS.

SERIES C.—SPECIAL REPORTS—

I. HOSPITAL PRACTICE.

II. PRIVATE PRACTICE.

The various reports to which the foregoing observations refer are given on the pages following. Then follow the record of cases of deaths remotely due to the chloroform, and the cases in which untoward symptoms arose but no fatal issue took place.

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860.

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
1	15	F	Removal of toe-nail ($\frac{1}{2}$ minute).	Handkerchief. 1 dr.		Anæsthesia incomplete. Became blanched; spluttered as in epilepsy; never rallied.	P.M. Stomach was distended with food. "Syncope" (Snow.)	Snow believed induction of anæsthesia was in this case too rapid.
2	35	F	Extraction of teeth (1 minute).	Dr. Morton's Ether Inhaler.* Large quantity.	P.	Operation nearly completed. Arms became rigid. P. ceased after being feeble; R. ceased about same time. Became livid. Death in 3 minutes.	Syncope. P.M. Nothing very remarkable save fluidity of blood.	Remarks as in previous case.
3		M	Fistula in ano (1 minute).	Towel or handkerchief. $\frac{1}{2}$ dr.	P.	Anæsthesia incomplete (?). Showed slight symptoms of feeling pain. The P., which was full and natural, sank. Death in 1 minute.	"Overdose" in way given (Snow). P.M. Heart enlarged, pale and soft.	Had had chloroform before. Was placed on his side.
4		F	Opening a sinus in thigh.	Handkerchief, 3 to 4 dr.		Put up her hand and said "I choke." Face immediately became pale; breathing embarrassed. Foamed at mouth. Anæsthesia incomplete. Death in 1 minute, probably before operation commenced.	P.M. Heart pale and friable.	Among measures adopted for resuscitation, was forcible inflation of lungs; this caused permanent distension of air cells.
5	2	F	Amputation of middle finger.	Handkerchief, 1 dr.	P. & R.	"Coughed a little; then gave a few convulsive movements." Anæsthesia incomplete. Death probably before operation commenced, probably in 1 or 2 minutes.		
6	22	M	Cantery to wrist.	Apparatus.		Death in 5 minutes.		
7	34	M	Amputation at hip for bullet wound.	Apparatus.		Breathing became stertorons and then very feeble; countenance livid; eyes turned upwards; P. had ceased. Artificial R. seemed to revive him and P. was again felt; he relapsed, however, and died. Death on re-application of CHCl_3 , when sensibility was returning.		
8	13	M	Extraction of teeth.	In ether apparatus.		Hands fell down and head fell on chest. Artificial R. but no recovery. Incomplete anæsthesia. Operation not commenced. Operation not commenced.		
9	2	M	Operation on great toe.					
10	17	M	Phimosis and for hæmorrhoids.	Napkin. 3 dr.	P.	Operation completed. Complete anæsthesia. Face and neck became livid; eyes turned upwards; P. imperceptible at wrist; and whole body relaxed. After 2 or 3 gasps he ceased to breathe. Death in 10 minutes.	Syncope. P.M. Heart large and flabby; lungs a good deal "congested."	Had inhaled CHCl_3 before. Some of same chloroform had been used for another patient without bad effects.
11	17	M	Amputation of finger, 5 minutes.	Dropped on gauze laid on face, 2 dr.	P.	He struggled for a moment, then after a quarter of a minute the P. ceased to beat; countenance altered. Action of heart had ceased and the sounds could not be heard. R. still continued, but became irregular, weak and slow; and at length ceased completely in space of $\frac{1}{2}$ minute. Attempts made to restore R., and in 2 minutes again commenced, but P. did not return. Death in 6 minutes, during stage of excitement.	Syncope (Snow). P.M. Vena Cava overfull of black blood.	Snow thinks an overdose was taken when the patient struggled.
12	36	M	Amputation of toe.	Handkerchief, $\frac{1}{2}$ oz.		Anæsthesia complete. At close of operation no blood escaped when pressure was removed from arteries; patient was, in fact, dying, and in a short time expired. A few inspirations were noticed after P. had ceased at wrist.	P.M. Some venous engorgement of lungs, heart flabby.	Death probably due to way the CHCl_3 was given (Snow).
13		F	Extraction of tooth.	Handkerchief.	P.	As she did not become insensible more CHCl_3 was placed in handkerchief. She drew one deep inspiration; countenance immediately became pallid; dilatation of pupils, convulsive rolling of eyes, no P. could be felt.	"Paralysis of heart by overdose."	The inspiration at the moment the fresh supply of chloroform was given probably induced intaking of a lethal dose (Snow). Pt. was sitting.
14	48	M	Removal of toe nail.	Inhaler. About $\frac{1}{2}$ dr.	P. & R.	Anæsthesia complete. Continued insensible after operation; face becoming dark, P. small, quick; R. laborious. After struggling for a minute became still. R. continued a few seconds after P. ceased. Artificial R. produced no effect.	Probably asphyxia (Snow).	
15		F	Excision of eye-ball.	Sponge. Small dose.	P.	Probably fully under. Died suddenly during operation.	Syncope.	"Vapour not sufficiently diluted" (Snow).

* Consists of glass globe containing a sponge on which the chloroform was poured to saturation. The globe was $4\frac{1}{2}$ inches across, and the sponge filled one-third of it.

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
16	20	F	Extraction of tooth.	Sponge and napkin.	? P.	Died suddenly, stretching herself out and frothing at the mouth at moment of death, countenance at same time becoming livid.	Syncope.	Operation seems to have been attempted several times at intervals unsuccessfully. Died when inhaling CHCl_3 for 6th time.
17		M		Sponge. 1 dr.	? R.	During stage of excitement, made a stertorous inspiration; and this occurred several times, until at length R. ceased entirely not. (No report of P.) Operation probably not commenced.	"Probably syncope."	
18	24	F	Amputation of finger.	Handkerchief. 1 dr.		Operation probably completed. After CHCl_3 was discontinued, face turned pale, and P. and R. ceased.	Syncope. P.M. showed Pt. to be emphysematous.	
19	30	M	On testicle.	Cotton and folded towel. About $2\frac{1}{2}$ dr.	P.	Some struggling on breathing fresh CHCl_3 Towel removed, but, patient not being insensible, again applied. After a few inspirations P. ceased, face turned pale, breathing slow and gradually ceased. Death in 5 minutes. Operation not commenced.	Cardiac syncope. Breathing returned for a time after the employment of artificial respiration. P.M. showed old standing disease of membranes of brain.	
20	7 or 8	M	Sounding for stone.	On lint.	P.	Insensible, moaning. Countenance livid, eye vacant. Heart pulsation ceased. Made one deep gasp, and was to all appearance dead. Artificial R. no result.	Syncope.	
21	34	M	Amputation of portion of band.	Inhaler, then napkin.	P.	During operation hæmorrhage suddenly ceased, and he expired.	Syncope. P.M. Heart flabby, some congestion of brain membranes.	See Snow p. 152.
22	24	M	Amputation below knee for scrofulous disease of ankle.	Lint and towel, with sponge, laid on face. About $1\frac{1}{2}$ dr.		Slight convulsive movement of eyelid, froth at mouth, and he was dead. Operation not commenced. Death in about 1 minute.	Syncope.—From commencement of administration to death only one minute elapsed.	Patient greatly debilitated.
23		M	On penis.	Chloroform, 1 dr.		Died suddenly.	Syncope.	
24	36	M	Extraction of teeth.	Handkerchief.		After extraction of some teeth, she died suddenly in less than 1 minute from commencement of the inhalation.	Syncope.—Pt. was emphysematous.	The administrator was prosecuted for homicide but acquitted.
25	15	M	Removal of testicle.	Linen cloth. About $1\frac{1}{2}$ dr.	P & R.	Fully under influence. During operation, hæmorrhage from artery suddenly ceased. R. ceased almost instantaneously with heart's action, but one or two sigh-like inspirations followed. With artificial R. there were several attempts at natural R. Death after more than 7 minutes.	? Syncope (Snow). P.M. Fulness of veins—fibrinous clot in pulmonary artery.	
26	37	F	Removal of impacted fæces. (Cancer of uterus.)	Probably handkerchief. $10\frac{1}{2}$ dr.		On completing operation the surgeon found that she had ceased to breathe. She was fully under anæsthetic. Death in 8 or 9 minutes.	? Syncope. Symptoms do not appear to have been observed.	
27	25	M	Ligature of arteries, aneurism in leg by anastomosis.	Apparatus.		Operation commenced. P. suddenly ceased as soon as skin incision was made; CHCl_3 removed, but in a few seconds patient had ceased to breathe. With artificial R. the act of R. was performed several times, and the circulation was thought to be returning, but this was only due to appearance of face; no pulse returned, but he quickly relapsed and died. Death in 5–10 minutes.	Syncope. P.M. Venous engorgement.	
28	32	F	Extraction of tooth.	Sponge and handkerchief. 25 drops.		Only 4 or 5 inspirations. Operation not commenced. On being asked a question, answered in a thick and trembling voice. At same time stretched out her limbs; face became bluish; eyes haggard; head and arms fell; she was dead.	Syncope.	Was in sitting posture.
29	75	M	Lithotrixy.	Snow's Inhaler.		Operation commenced. Fully under. Fresh CHCl_3 given as signs of returning consciousness appeared. Appeared to hold his breath; P. had then ceased, the heart sounds were still heard feebly. Made several further inspirations and then ceased to breathe. Artificial R. produced no result.		
30		M	Fistula in ano.	Handkerchief. About 1 dr.		Not fully under; operation not commenced. On applying fresh CHCl_3 he spluttered at mouth. CHCl_3 was removed, but he suddenly expired. Death in about 1 minute.	Syncope.	

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
31		M	Application of potassa fusa to ulcers.			Fully under. When nearly completing operation a sort of catch in breathing on looking at him, mouth and eyes open and turned upwards; breathing irregular; face pale, and pupils dilated. Artificial R. had no effect. "In a few minutes the man died."	Probably syncope.	
32		M	Removal of malignant tumour of the thigh (12 minutes).	Inhaler.		Fully under. CHCl_3 acted slowly. During operation breathing became slow; seemed to be sinking fast, gave one strong gasp, and then died.	Probably syncope.	
33	28	F	Application of nitric acid to sloughing ulcers.	Lint.		Operation not commenced. During stage of excitement, a partial relaxation of the limbs took place, became insensible and pulseless.	Syncope.	
34		F	Tumour of face.	Compress.		Stage of excitement. During operation had cough; made a deep inspiration, then a convulsive movement of face and hand. P. and heart had ceased.		
35		M	For hæmorrhoids.			Fully under. Operation not commenced. R. became embarrassed; there was trismus; then the movements of heart ceased. With insufflation, and then with electricity he breathed irregularly for 20 minutes. There was, however, no evidence of restored action of the heart. Death in less than 5 minutes.		Patient suffering from aneurism of the aorta.
36	25	M	Removal of tumour near lip.	Sponge. 5 dr.		Fully under. Operation commenced. Became pale, R. suspended, sank into state of complete collapse. Artificial R. produced no effect. Death in about 4 minutes.	Syncope.	
37	43	M	Perineal section.	Handkerchief. About 1 oz.	P.	Fully under. Operation not commenced. Had slight convulsion; rallied and continued CHCl_3 ; P. became weak and ceased. Breathing did not cease before P. Artificial R. restored a few natural Rs, but this did not continue.	Syncope.	
38	40	F	Strangulated hernia.	Lint. Less than 2 dr.		Operation not commenced. Struggled much; commenced to breathe with loud, rough stertor; P. was gone, gave several inspirations, then ceased. With artificial R. and galvanism gasped about 3 times. After this no further signs of life.	"Simultaneous deep coma and cardiac syncope."	
39	22	F	Application of actual cautery to canceroid sore.	Inhaler. About $2\frac{1}{2}$ dr.		Fully under. Operation not commenced. P. became extremely weak and fluttering; countenance dusky; R. at long intervals with slight catching efforts. All efforts at R. ceased about 2 minutes after 1st indication of failure; P., however, as a very feeble flutter, was felt occasionally for at least 2 minutes later.	Syncope.	
40	19	M	Extension of ankylosed knee.	Inhaler. Chloroform 1 dr.		Probably not under influence. Operation not commenced. P. became feeble and undulating; trismus occurred; R. became irregular, face livid; foamed at mouth. Only once made feeble attempt at R. Death in less than 1 minute.	Syncope.	
41	13	F	Lipoma on back.	1 dr.		Fully under. Operation commenced. Fell suddenly forward on chest. Attempts made to restore her; but in a few minutes it became evident that she was dead.		
42	59	F	Attempt to reduce dislocation at shoulder.	Sponge. 2 drs.	R.	Respiration became stertorous, and immediately afterwards the pulse, which had hitherto continued pretty firm, became imperceptible, respiration ceasing at same time. "Galvanism" applied; some convulsive efforts of respiratory muscles, but no further sign of life; about 6 minutes. Not commenced.	"Deep coma and cardiac syncope"	
43	45	F	Removal of cancer of breast.		P	After inhaling with little effect for forty minutes the chloroform took effect, but the countenance changed and pulse ceased; after a few short laboured inspirations life became extinct. Fully under. More than 40 minutes.	Cardiac syncope.	
44	40	F	Removal of uterine polypus.	Lint.	P.	Pulse ceased to beat; face was extremely pale; a slow respiration still continued, but soon ceased. Fully under. Time not stated.	Cardiac syncope.	

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks
45	18	M	Operation for phimosis.	(Not covering nostrils) 2 drs.	P.	Pulse suddenly failed, became imperceptible; countenance assumed a pale, leaden hue. With stimulus of cold water, after three or four minutes, pulse again felt, and spontaneous respiration renewed. This improvement continued for ten minutes; then pulse and respiration ceased together. Artificial respiration produced no effect. Complete insensibility. About 6 minutes.	Cardiac syncope.	
46	39	F	Removal of tumour of breast.	Rather more than 1 dr.		Breathing suddenly ceased; became deadly pale. No pulse could be felt; there were then two sighing efforts at respiration. Artificial respiration commenced within one minute, without effect. Commencing to inhale. One minute and a half.		
47		M	Reduction of dislocation of hip.	Apparatus (which mixed air with the chloroform).	P.	Pulse ceased, became pale; the respiration continued, but slow and irregular. Friction, ammonia, artificial respiration; the arms were raised and some pulsations were again felt. Appeared to answer questions, but then fell back again into a state of syncope. Reduction effected. Complete anæsthesia. A few minutes.	Syncope.	
48	13	M	Cleft palate.	A compress, held two centimetres in front of mouth.	P.	Pulse ceased; strange expression of face. With artificial respiration and cautery there were two or three efforts at respiration. Fully under during the operation.	Syncope.	
49	65	M	Amputation in thigh. 13-14 m. n.	Snow's Inhaler. 3 drs.	P. & R.	Pulse, which was full and steady, gave a few rapid, irregular beats, then ceased; respiration ceased simultaneously; face became pallid and deathlike. Artificial respiration was followed by slight effort at inspiration. Stage of excitement 14 minutes.	Syncope.	
50	39	M	Introduction of catheter.	Lint.	R.	Began to snore; then a long interval; breathing became feeble and was ceasing; artificial respiration then used, and after a few minutes it then recovered, but again ceased. The pulse had continued to beat some little time after these symptoms, and after cessation of respiration. Fully under.	"Deep coma, apnea, syncope."	
51	56	F	Amputation of leg. 3 minutes.	Lint, in oil silk. 2 drs.	P.	Pulse suddenly ceased in femoral; then several respirations, which ceased, but were renewed slightly with artificial respiration. Fully under. About 3 minutes.	Syncope.	
52	40	M	Excision of eyeball. 5 minutes.	Snow's Inhaler.	P. & R.	Respiration became feeble and sighing. With artificial respiration there was occasional breathing, but this presently ceased. Pulse, when felt for after spasm subsided, was absent. Operation not commenced. Death during stage of excitement.	Syncope.	
53	29	F	For relief of facial neuralgia. A few seconds.	An Inhaler. $\frac{1}{2}$ dr.		Having inhaled 20 minims, she heaved for more; began to inhale eagerly; gave a sudden start, as if taken in some kind of fit. No further sign of life. Not fully under.	Syncope.	Was sitting up, had inhaled 2 or 3 times before.
54	36	F	Tooth extracted? A few seconds.	Handkerchief. About $1\frac{1}{2}$ dr.	P. & R.	Spoke and said, "I am not over yet," and immediately while yet speaking, she gave a convulsive start, and, with a stertorous inspiration and with the eyes and mouth open, sank to the floor. Artificial respiration was employed, and after a short time there were a few spontaneous inspirations, and it is said the pulse could be perceived at the wrist. Quite conscious. Death in about a minute. Operation not commenced.	Syncope.	Sitting posture. Had inhaled chloroform 4 times previously
55	30	M	Removal of necrosed bone from finger. 3-4 minutes.	Spunge in lint.		Raised hands and trembled, kept spitting at the lint; appeared about to vomit. Suddenly he was violently convulsed, as if in an epileptic fit. The chloroform was at once discontinued and he was laid in a semi-horizontal posture. The convulsion lasted only a few seconds; he began to breathe with effort, and to gasp irregularly. His pulse was almost imperceptible and intermittent. With artificial respiration he rallied, and breathed without assistance. In a few seconds he relapsed, and could not be recovered. Not fully under. Operation not commenced.	Deep coma and cardiac syncope.	Sitting posture.

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks
56	9	M	Excision of scapula. A few minutes.	First an inhaler, then lint.	P.	After making one long, deep inspiration (from lint) appeared to pass into a deep sleep. A few seconds later, pulso began to beat very quickly, then ceased for two or three seconds, then beat rapidly several times and ceased. He continued to breathe for at least a minute longer. Respiration was ceasing, but continued, with cold water, &c., for two or three minutes. Brandy poured into the mouth passed into œsophagus, but no effort to swallow. Artificial respiration produced some efforts at inspiration; but he did not rally. Under influence. Operation not commenced. Death in a few minutes.	Syncope.	
57	35	M	Amputation of thigh. A few minutes.	Lint, not a large quantity.	P.	On raising eyelid it remained retracted; eyes slightly turned up. No pulsation in temporal or wrist. The respirations had almost ceased. With cold water, &c., respiration became better; in about 2 minutes a pulse was felt at the wrist. This continued, with good respirations, 2 or 3 minutes. The pulse then failed, and then the respirations. Artificial respiration produced no effect. Fully under. Death in a few minutes, 10 minutes from the time on table till death, but had inhaled in the ward 3 or 4 minutes before). Operation not commenced.	Syncope.	
58	17	F	Application of nitric acid to sores.	Snow's inhaler. 1 dr.		The operation being completed, moved as though recovering, and was left. A few minutes later, being noticed to be pale, was found pulseless and dead. Artificial respiration produced no effect. Fully under. Operation completed. Death in few minutes.	? Syncope.	
59	49	M	Excision of elbow joint. Two minutes.	Hollow sponge. About 1 dr.	P.	Gasping respiration followed by "slow convulsive movement of limbs." The pupils became dilated, and the pulse stopped. Not under influence. Operation not commenced. Death in about 2 minutes.		
60		M	Extraction of teeth.			"Died suddenly."	? Syncope.	Sitting posture.
61	23	M	Plastic operation on forehead.	6 drs.		Great excitement, with tossing about of limbs, followed by sudden collapse. Not fully under influence. Operation not commenced.	? Syncope.	Intemperate.
62	32	M	Removal of finger.	About 2 drs. used, given in 30 minim doses.	R.	The chloroform caused a little cough at first, which soon ceased, and the stage of excitement set in. When nearly insensible, he did not breathe freely, and there was spasmodic action of the larynx, as if from repeated swallowing of saliva. Chloroform was discontinued, and respiration had entirely ceased. No pulse could be felt. Artificial respiration and other means produced no effect. The heart's action continued for some time after the breathing and pulse had failed. Anæsthesia nearly complete. Operation not commenced.	? Asphyxia. P.M. Frothy mucus throughout air-passages. Lungs healthy. Heart substance healthy and firm, a little fat on external surface of left ventricle; valves natural.	
63	11	M	To examine an injury of the foot, of some weeks' standing.	Cotton handkerchief.	P.	The boy was much frightened, and breathed irregularly at first. Fresh chloroform was added, and after 6 or 8 inspirations he became insensible. The handkerchief was given to the mother to hold and the examination of the foot commenced. Stertor set in, and the chloroform was discontinued. Pulse became imperceptible; lips livid. Artificial respiration produced a few short inspiratory efforts. No return of pulse. Extreme insensibility. Death in ten minutes from the commencement of inhalation.	? Overdose leading to paralysis of respiratory and cardiac centres.	

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P or R.	7 Symptoms occurring under anæsthesia.	8 Assigned cause of death.	9 Remarks.
64		F	Extraction of tooth.	Handkerchief.		"Seized with alarming symptoms." Operation completed.		Sitting posture
65	8	M	Operation for strabismus.	Piece of lint. About 1½ dr. used at 3 applications.	P.	He flinched as the operation was commenced. More chloroform poured on lint. Face instantly became pale, and pulse ceased. Up till this had been quite regular, 80 per minute. Incomplete anæsthesia.	? Syncope.	
66	45	F		Handkerchief.		Death in ten minutes.		
67	43	M	For reduction of subcoracoid dislocation.	Piece of linen rolled into cone. From 4-5 drs. used.	P.	Excitement followed the fresh application of chloroform, but soon passed off. Operation completed. Pulse and respiration regular; when pulse suddenly stopped; a few rapid, deep inspirations continued. Anæsthesia. Chloroform had been removed and remarks were being made by operator. Reduction effected.	? Syncope.	
68	7½	F	Forceful straightening of hip-joint.	Sponge. About 1 dr.	P.	Resisted when touched. On second attempt crying and struggling ceased; circulation had stopped; lungs continued to act for a few respirations. Incomplete anæsthesia. Operation not commenced.	? Syncope.	
69	15	F	Operation for strabismus.	Piece of folded linen.	P.	She gave a shriek and became insensible. The operation was commenced. Face became livid; pulse could not be felt; slight inspiratory efforts at intervals for a long time, and movement of nostrils, for at least half an hour, after cessation of pulse. Complete insensibility. Operation just commenced.	? Respiratory paralysis.	
70	45	M	To make incisions for extravasation of urine.	Inhaler. 1½ drs. used.	P.	The addition of half a dram of chloroform produced insensibility, and inhaler removed. Face became pallid. Pulse fluttered, and ceased. Respiration continued for one or two minutes. Anæsthesia. Operation completed.	? Syncope.	
71	28	M	Amputation of foot for an old injury.	Inhaler. 1 dr. used.	P.	When about half a dram had been taken pulse suddenly failed; face pallid. Inhaler removed. Gave a few gasps, passed urine, and died. Not under influence. Operation not commenced.	Syncope.	Had been fully under influence for an hour and a half for a previous operation. Intemperate.
72	24	M	To apply nitric acid to syphilitic sores.	Cone of lint covered with oiled silk. About 2½ drs. given at intervals.	P. & R.	Resisted the application of the acid. Struggling suddenly ceased; face pallid; pulse and breathing stopped. Artificial respiration produced a few inspiratory efforts. Imperfect anæsthesia. Application commenced. Dead in twenty minutes.		
73	57	M	For delirium tremens, following a fracture of tibia and fibula involving the knee-joint.	Piece of lint. About ½ dr.		After two or three inspirations the man "writhed" and fell back dead. Not under influence.	? Syncope.	Very intemperate.
74	50	F	To reduce dislocation of shoulder.	"A simple compress."	R.	Reduction effected. Chloroform removed. Face became congested. Respiration failed, then stopped. Death-like pallor. No pulse. Artificial respiration and galvanism caused inspiratory efforts, but no return of pulse. Complete insensibility. Operation completed.	Respiratory failure and syncope.	
75		F	To relieve neuralgic pains.	Upon a cloth.		The last dose given at nine o'clock; found dead at ten. Supposed to be asphyxiated. Had taken it twice to insensibility on the same day.	? Asphyxia.	In the habit of taking chloroform, in this way, very frequently, and in enormous doses.
76	55	M	Perineal section for old stricture of urethra.	Inhaler. About 1 dr.	P.	Took chloroform quietly; breathing natural. Face turned pale, and pulse ceased. A few faint inspiratory efforts afterwards. None followed artificial respiration. Complete anæsthesia. Operation just commenced.		Very intemperate.

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
77	29	F	Extraction of tooth. 4 minutes.	Handkerchief folded in a cone. About 1 dr.	P.	Forty drops sprinkled on the handkerchief produced excitement after 1½ minutes to 2 minutes' inhalation. Twenty more were added, and the excitement passed away. Pulse good; breathing calm; eye sensitive to touch. Suddenly the head fell to one side, face became pallid, pupils dilated, pulse ceased; she gasped a few times convulsively. Artificial respiration and galvanism produced a few inspiratory efforts, but no return of pulse. Partially under influence. Operation not commenced. Death in less than four minutes.	? Syncope.	Highly nervous and hysterical. Sitting posture.
78	42	M	Excision of the elbow-joint (following injury a month previously).	A piece of lint, 2 drs., the second dram applied four minutes after the first.	P.	At first breathing regular and pulse somewhat quickened; about one minute after the second dram was applied the man struggled and tried to raise himself; the pulse suddenly failed, breathing continued for some minutes, and the lips remained florid. The tongue was immediately drawn forwards, artificial respiration and galvanism commenced, and continued for three-quarters of an hour, but of no avail. Slightly under influence. Operation not commenced.	? Syncope. P.M. Heart and right lung healthy; the left so infiltrated with tubercle as to render it almost useless for respiration.	
79	30	M	Operation for removal of necrosed portion of tibia. 6-7 minutes.	Inhaler. About 2 drs.	P.	Took the chloroform well, breathing regular and even, as also was the pulse. Operation commenced in 5 minutes, and a minute later the pulse, which was continuously watched, ceased instantaneously; the breathing continued unchanged for several seconds, when the face became pale, and the respirations lower, and soon stopped. Ammonia to nostrils, cold affusions, artificial respirations by compression of chest and by Sylvester's method, galvanism to cardiac region, and two needles passed into the heart, produced no result. Complete anaesthesia. Operation commenced. Death in 6 to 7 minutes from commencing to inhale.	? Syncope. P.M. 23 hours after death. Brain dark, vessels congested, especially those of the cerebellum. Pericardium contained a quantity of turbid yellow serum. Heart; mark of one needle about an inch above the apex, the other an inch above this, both in left ventricle, which was partially contracted; right, not so; valves healthy; slight fatty deposit amongst fibres of right ventricle, none on left side; to the eye the muscular tissue of the heart was perfectly healthy; lungs healthy; slight congestion below and behind on both sides; abdominal viscera normal, but rather congested. The blood was universally fluid.	Apparently a very healthy man.
80	28	M	Operation for fistula in ano. 8-10 minutes.	Inhaler. 1½ drs.	P.	He breathed quietly for 6 or 8 minutes, and then struggled violently. Had a sort of tetanic spasm, back curved so as to rest on his head and heels. The chloroform was suspended during this excitement. Pulse regular, good. The inhaler was about to be re-applied, when the pulse in the temporal artery intermitted twice, and ceased. The body became ashy pale, patient gave 3 inspirations, each shorter than preceding, and breathing stopped, pupils natural. Cold affusion, ammonia to nostrils. Artificial respiration by Sylvester's method, and galvanism, were of no service. No heart sounds could be heard. Partially under influence. Operation not commenced. Death in 8 to 10 minutes.	? Syncope. P.M. 48 hours after death. Heart apparently healthy, so far as muscular tissues are concerned; rudely in colour; cavities dilated, and their walls thin. Lungs universally adherent; they contained some scattered tubercle and one small vomica. Liver large, pale, fatty. Kidneys natural.	Not good health. Intemperate. On Jan. 10, 1863, he had been operated on, under chloroform, for an exostosis of the femur, without any ill effects from its use.

SERIES A.

DEATHS UNDER CHLOROFORM.

CASES FROM ROYAL MEDICAL CHIRURGICAL SOCIETY'S REPORT BETWEEN 1848 AND 1860 (*continued*).

1 Reference	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
81	22	M	Operation for phimosiis.	Weiss' apparatus.	P.	Was a little nervous, pulse good. In about 4 minutes face became slightly congested, and pt. struggled to rise in bed. Face became dusky and lips blue. Cold affusion to face and compression of ribs caused a deep inspiration, but pulse could not be felt. Artificial respiration, and other measures, were tried; he breathed at intervals several times, but respirations became fainter, and at length ceased. Partially under influence. Prepucce removed.	? Syncope.	He expressed no dread of chloroform but always had a great horror of it, and possessed an idea it would kill him.
82	14	M	Extraction of tooth.			The patient was seated; he had syncope, and died.	Syncope.	Sitting posture.
83	15							
84	60	M	Reduction of dislocated hip. 20 minutes.	Apparently on handkerchief.		Very violent efforts necessary for reduction, which was at length accomplished, when symptoms of "cerebral congestion" set in. "Never fairly under influence." Operation completed. Death in 20 minutes after the chloroform was removed.		
85		M	To reduce a dislocated humerus.		P.	Took chloroform readily, just as reduction was effected pulse stopped, and, after a few gasps, breathing also. Artificial respiration and galvanism produced no effect. Under influence of chloroform operation completed.	? Syncope.	
86	23	M	Amputation of leg at the lower third for disease of the bones of the foot.	Piece of lint. "A considerable quantity."	P.	The man moved the limb slightly, and more chloroform was applied, when he suddenly became deathly pale, and his pulse ceased; "aspect like that of a corpse." The tongue drawn forward, and artificial respiration by compressing the chest kept up for half an hour. Efforts at inspiration occurred at intervals of from thirty seconds to a minute, for eight or ten minutes after the pulse had ceased—some of them of considerable force—so as to lead to a hope of a favourable issue; but no return of pulse or of colour to the face. Once or twice, with inspiration, a movement of the neck and right arm. Galvanism produced no effect beyond a quivering of the muscles. Anæsthesia produced without anything unusual occurring. The limb was removed and the arteries were being tied.	? Syncope. P.M. twenty hours after death. Blood perfectly fluid "like thin tar and water." Heart flabby, moderately full, no coagulum, valves healthy, muscular substance healthy, both to the eye and under the microscope. Lungs contained more air than usual, everywhere crepitant, did not collapse much on opening chest, no tubercle anywhere. Liver and kidneys normal.	Patient very wasted and debilitated from disease, supposed to be phthisical.

SERIES B.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS.

1	27	M	Avulsion of great toe-nail. 2 or 3 minutes.	On towel.	P.	The first two doses (? amount dropped on towel) produced no effect, the third produced insensibility. The operation took but a minute or two and was completed, but patient never returned to consciousness. Colour of face changed and pulse failed. Artificial respiration for $\frac{1}{2}$ an hour was useless.	Syncope. "The chloroform given in a dangerous way (open towel) instead of an inhaler."	Was suffering from cardiac disease as shown by P.M. Had taken chloroform repeatedly on previous occasions.
2	?	M	Avulsion of toe-nail.		?	?	?	?
3	?	M						
4	?	F	To quiet fit of mania.	On lint.	?	?	? Syncope. Congestion of lungs.	Lunatic subject to violent fits of mania. In the last stage of exhaustion. Had often taken CHCl_3 before.
5	40	M	For circumcision.	Napkin $1\frac{1}{2}$ ozs.	R.	Stertorous breathing followed by failure of R. Measures resorted to were artificial lt., galvanic battery to chest and neck; inflation of lungs by tube and bellows; rubbing limbs.	? Syncope. P.M. Heart fatty; lungs congested with apoplectic clots; œdematous and less crepitant than usual.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
6	42	M	For removal of lipoma on back. 3 or 4 minutes.	On single fold of thin lint. 5½ drs.	P. & R.	Patient became excited, struggled and talked. This ceased and face became congested and breathing stertorous. On patient being turned over on left side breathing ceased suddenly. Artificial R. by Marshall Hall's method and electro-magnetism employed for 1 hour, but failed. No P. or heart beat observed after R. first ceased.	Failure of R. and heart action together. P.M. Lungs engorged with venous blood; heart large, flabby, myocardium soft, ventricles thinner than usual, right side distended, left empty, blood fluid.	Patient a tall, stout, muscular man; inveterate drinker. Anæsthetic given at his own request, though dissuaded by surgeon. Chloroform quite pure.
7						When untoward symptoms came on artificial R. resorted to, contraction of heart kept up for 1½ hours, and a few natural respirations obtained.		
8	24	M	For ingrowing nail.		P.	After cessation of pulsations of heart, patient made at intervals spontaneous inspirations and expirations.	? Syncope	
9	40	M	For amputation of leg. Administration just begun.	Diluted.	P. & R.	Had scarcely made 4 inspirations when R. and circulation were suddenly arrested, and so remained in spite of all means employed. [Surgeons objecting to chloroform being given, and man wishing for it, a small quantity at some distance from mouth was given.]	? Syncope.	Strong man. Leg crushed by fall from horse. Syncope at time of accident. Very nervous.
10		M	For operation for glaucoma. ½ hour.		R.	Sickness; the "anterior chamber of eye just opened, filling with blood;" sudden fit, gasping, &c. A crowd assembled round patient; Marshall Hall's method of artificial R. tried; rubbed with ice for ½ hour, P. keeping good. At length P. ceased.	?	Patient a strong and muscular man; the operation very trivial.
11	7	M	For tracheotomy for laryngitis.			Patient seemed relieved by inhaling the CHCl ₃ ; but no sooner was the tube within the trachea than he gasped and died. Artificial respiration was resorted to for 25 minutes; cold water affusions and external stimulants. All with no effect.	? Asphyxia. P.M. Tissues of larynx infiltrated; general engorgement with marks of ulceration; lymph puriform; epiglottis thickened and erect.	Symptoms of laryngitis very urgent; pulse 120; vital powers oppressed.
12	31	M	To induce sleep in delirium tremens.	Handkerchief.	R.	R. impeded. Chloroform suspended. Artificial R. Patient gave one deep breath and two slight ones. Other means resorted to were pulling out tongue, cold affusions, rolling body on side, continued for 20 minutes with no avail.	? No P.M. allowed.	Intemperate for long time.
13		M	Extraction of tooth.	On handkerchief.	?	After extraction of tooth convulsive agitation set in, which became violent, and patient expired. Restorative means used but not stated.		Sitting posture.
14			Extraction of tooth.					Sitting posture.
15					R.	Sudden embarrassment of R. and sudden dilatation of pupils.	Suffocation. P.M. Lungs studded with tubercles and gorged with blood.	
16	32	M	Amputation of left leg for scrofulous disease.	Fold of bandage.	P.	Patient seemed to come rapidly under influence when suddenly, sphincters relaxed, lips quivered and patient died. Breathing continued after heart ceased beating. Galvanism and artificial R. used to restore life.	"Fear, Debility, and Chloroform" (Verdict of jury). P.M. Right cavities of heart filled with fluid blood.	Debilitated.
17	35	M	Passing catheter.	5j. (on lint).	R.	Operation about to be begun when patient ceased to breathe and animation seemed suspended. Galvanism and artificial inflation in turn employed but failed. Pupils dilated, lips livid.	Failure of R. P.M. Pyelonephritis, left kidney. Right kidney healthy, slightly enlarged, walls of bladder thickened, urethra obstructed.	
18								

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
19	50	M	For removal of internal piles.	Hollow sponge. 3ij. yearly.	P.	While struggling continued some stertor appeared; in another minute full stertor; face dusky and livid, without pallor; P. ceased and R. became slower, operation not begun. Measures adopted were: Artificial R. slapping face and chest with wet towel; blood-letting from jugular vein; rubbing limbs; electro-magnetism.	Syncope. P.M. Heart loaded with fat, muscular substances thin and weak, walls of right auricle and ventricle in state of fatty degeneration, same cavities gorged with fluid blood.	Patient large, stout, very muscular; abdomen prominent. Seemed given to drink. Arcus senilis; P. and R. natural.
20	8	M	For plastic operation for deformity caused by burn on chin.			Just before conclusion of operation patient fainted. Measures employed were artificial R.; then warm bath and galvanism. Was recovering from CHCl ₃ , when bad symptoms came on.	Paralysis of heart. P.M. appearances nil.	
21		M	For reduction of fractured ankle.					
22	36	M	For putting stiffened leg in splint in case of diseased hip-joint.	3jss. Snow's inhaler.	P.	After inhaling for 1 minute had violent shaking fit; inhaler was removed, and he became calm. CHCl ₃ again given; when at rigid stage and was trying to raise himself, muscles relaxed rapidly; he fell back, became pale; breathing laboured, and P., hitherto good, stopped. Measures adopted were artificial R. (for 1½ hours), galvanism, acupuncture.	? Syncope. P.M. Heart large, cavities full of fluid blood; loaded with deposit of fat. Liver, kidneys and brain much congested.	
23		M	For removal of two cysts—one on lid, other on tongue.	3ij. On lint.	P.	On inhaling patient became excited; when convulsions ceased fell into collapse; had 3 violent fits of sneezing and heart ceased beat; breathed several times at long intervals.	Syncope.	Patient a feeble subject.
24	35	M	For removal of left testis for malignant disease. 4 minutes.		P.	Soporose breathing commenced, pulse became feeble; chloroform withdrawn, but P. rapidly failed, and in 20 seconds ceased beating. Patient made 8 or 10 regular and 2 or 3 irregular respirations and inspirations after heart ceased. Cold water, fresh air, Marshall Hall's method of artificial R.; ammonia to nostrils, friction to extremities, and galvanic current from spine through thorax to diaphragm. All these for 1 hour.	? Syncope. P.M. No trace of organic disease; blood fluid and organs generally congested. When heart ceased beating ventricles dilated, valves quite healthy; no fatty degeneration.	Patient a fine muscular man.
25	33	M	For fistula in ano. 10 minutes.	On lint folded on handkerchief. ¾ oz. Not given in measured quantity.	R.	Patient struggled violently, raised himself on seat, and stopped breathing. Window was opened. Marshall Hall's method of artificial R. and other methods tried.	Paralysis of R. P.M. Heart and lungs found to be extensively diseased. This verdict was disputed as P.M. took place 16 days after death.	Patient in excellent state of health, quite fasting before administration, heart and lungs in excellent state.
26		F	For examination of shoulder joint.	Quantity small.				Chloroform used of unexceptionable quality.
27	16	M	Amputation of great toe for disease of bone. 5 minutes.	No apparatus to determine quantity.	?			Patient said to be very healthy.
28	40	F	For removal of tumour on lower jaw.	2 dr. (Is not quantity under-stated?)	P.	Before operation was finished patient became slightly conscious. After second dose she took one inspiration and pulse stopped suddenly. She gave three or four gasps, and in half a minute was dead. Every effort made to restore animation without effect.	P.M. Fatty degeneration of heart.	
29	17	F	For operation on sphacelated wound consequent on a fall.	2 dr. Napkin.	P.	Operation begun, after second dose took one inspiration and P. ceased suddenly. Every effort made to restore animation with no avail.	? Syncope. P.M. Heart feeble and fatty.	Patient of nervous temperament and suffering from fatty degeneration of heart. Chloroform given very cautiously
30	23	M	For amputation for diseased knee.	Snow's inhaler.	R.	R. failed, P. kept good. Larynx opened; stimulant given; Marshall Hall's method of artificial R. kept up.	Failure of R. P.M. appearances nil.	
31	27	M	Fracture of leg.					

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
32	29	F	For removal of small tumour of gum (? opulis).			Died in an instant.	? Syncope.	
33	60	F	For reduction of strangulated umbilical hernia. 11 minutes.	3½, 160 minims.	P. & R.	Operation commenced and twice interrupted (1) by coughing, and (2) by vomiting. At 4 minutes after the inhalation the operation, about $\frac{1}{3}$ completed, was stopped, and patient became so feeble that restorative measures were used. In 4 minutes more, died.	Rupture of stomach, together with previous great exhaustion. P. and R. failed till both ceased. Stomach completely strangulated and ruptured in the peritoneal coat and back of the cardiac pouch.	Patient corpulent, greatly exhausted, had vomited for 6 days, and had been constipated 3 days. Was operated on for strangulation 10 years before.
34		M	For amputation of finger.		P.	Died instantly. P. ceasing and face becoming discoloured. Artificial R. and galvanism tried without success.	Syncope.	
35		M	For fistula in ano.		R.	Convulsed. Allowed little fresh air, CHCl ₃ again given; still convulsed, suddenly ceased breathing, usual remedies for resuscitation.	P.M. Lungs unhealthy, heart fatty. Apnoea (probably) but would seem from symptoms to have been syncope.	
36		F		1 dr. Handkerchief.	R.	Head was observed to fall on one side, and the breathing ceased suddenly.	Syncope.	A nervous hysterical woman.
37								
38								
39	38	F	Vesico-vaginal fistula.	Inhaler. 3½ss-ijj.	P.	Suddenly seized with spasm of respiratory and other muscles. P. failing though heart beating. Artificial R., galvanism and cold affusions used in vain.	Syncope. P.M. Heart flabby and fatty.	Weak, irritable and nervous, had had 9 children and 1 miscarriage at end of 3rd month. From end of last confinement had suffered from incontinence of urine.
40		F	For removal of tumour at back of neck.			Operation skilfully performed, but insensibility protracted. At end of $\frac{1}{2}$ hour limbs moved spasmodically, ending in convulsion and death.	? Syncope.	
41	41	M	For excision of joint (right arm).		P.	Pulse became feeble, galvanism and other remedies applied for $\frac{1}{2}$ hour with negative result.	P.M. Heart fatty and weak in structure.	
42		M						
43		F	For fistula. 7 minutes.	2 dr.	R. & P.	Patient struggled slightly. After operation consciousness did not return, and R. became slower, and ceased in 3 minutes. Measures adopted were: cold water in face, sal volatile, galvanic apparatus and Marshall Hall's method to procure artificial R.	Cessation of R. apparently, but medical opinion inclined to rank it under heart failure. P.M. Heart fatty, flabby, and deformed, walls of left ventricle very thick, of right very thin; liver enlarged, pressing upwards against lungs. Lungs very small, gorged with blood, and with black patches, showing death from chloroform.	Patient large and well made, seemed to have no heart disease, but suffered occasionally from indigestion.
44	16	F	For operation on bare lip. 5 minutes (about).	(1) By inhaler, with no effect. (2) on lint. Patient seated in chair.	P.	Before complete insensibility, pupils dilated rapidly, patient fell back, became pale and lips bluish. Artificial R. tried for $\frac{1}{2}$ hour with no effect.	Syncope. The pulse was not felt continuously but occasionally. The coroner's opinion at inquest was that continuous watching of P. might have saved life of patient. The operator, Mr. Gay, considered immediate cause of death to be palsy of involuntary muscles (see letter, <i>Ibid.</i> p. 578.)	Heart considered sound. Sitting posture.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
45		M	For passage of catheter.	4 drs.		"The reporter thought the man had fainted; it was not the usual congestion." Died in an instant, 20 ozs. of blood were taken from arm as chloroform restorative.	Syncope.	Perfectly healthy.
46	30	F	Extraction of teeth.			After 6 or 8 teeth had been extracted patient ceased struggling—whole system became relaxed and appearance death-like. Efforts for resuscitation made for 3 hours which proved unavailing.	Syncope. Inquest and P.M. held but result not known.	Sitting up.
47	21	M	For removal of tumour affecting nasal region. 9 minutes.	Towel.	R.	Profuse hæmorrhage; R. became very low. Artificial R. resorted to (Sylvester's method) succeeding for a while, but in 23 minutes respiration ceased entirely.	"Apnoea from effects of CHCl_3 and loss of blood." P.M. Heart and lungs healthy; lungs gorged with blood in patches, fluid blood on both sides of heart. Liver and kidneys gave signs of death from suffocation. "Died from the effects of the vapour."	A question arose as to the quantity administered to patient on a similar occasion two years before, and the absence of books of reference in such cases in the hospital. The jury expressed an opinion that proper case books for reference should be kept in the hospital.
48	29	F	For removal of tumour of urethra.					
49	56	M	Avulsion of great toe-nail.				Fatty degeneration of heart.	
50	F		For extraction of tooth.	Napkin.	P. & R.	Only slightly under; after operation face became livid, jaws clenched; breathing arrested; patient died.	Syncope.	Sitting posture. When examined beforehand, no trace of heart disease.
51	15	M	Amputation of leg.	Napkin.	P.	Patient never fully anæsthetised, during operation screamed out; then signs of failing circulation came on, and death ensued in 10 minutes. Methods resorted to were cold affusions, ammonia, drawing forward tongue, artificial R. and galvanism.	Shock. Doubtful whether CHCl_3 exerted any influence. P.M. Heart healthy. Lungs congested. Brain very large and well developed (60·89oz. avd.)	Nothing in state of heart appeared to forbid use of chloroform.
52	24	M	Removal of bone from right foot. 2 to 3 minutes.	Snow's inhaler. 40 minims.	P.	P. suddenly became imperceptible. Pupils not dilated and breathing natural. Inhaler removed. R. became deep and sobbing, and tongue protruded between teeth. No return of P., but R. continued 1 minute after P. ceased. Restorative measures were:—Cold douche, brandy injection per rectum, solution of ammonia on lint to nostrils, galvanism (forceps not needed as tongue did not fall back), artificial R. for half-hour.	Syncope. P.M. Both lungs healthy, right more congested than left. Ventricles contracted and empty, auricles with blood valves and muscular tissue healthy. By microscopical examination, ultimate fibres free from oil globules and striae well marked. Walls of left ventricle slightly hypertrophied without dilatation. Aorta healthy.	Patient healthy looking. By examination nothing to contraindicate use of CHCl_3 .
53	33	M	For cauterisation of sloughing sore on penis.	Inhaler. 2 drs. in separate doses of 1 dr. each.	P.	After inhalation of first dose, holding his breath and trying to avoid the vapour (which was diluted however) so that much was wasted. After he had spat second dose given, but he struggled so much that P. could not be watched continuously. Suddenly pupils became widely dilated and P. ceased. On removal of inhaler he drew deep gasping breaths for $\frac{1}{2}$ minute. Restorative measures: cold splashings, Marshall Hall's method of artificial R., and after by Sylvester's method, brandy injection, galvanism, friction.	Syncope. P.M. Heart of normal size, ventricles partially dilated, and both with fluid blood. No valvular disease. No fatty degeneration.	Patient healthy-looking. Chloroform given by his own desire.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
54		M	For amputation of leg for gun-shot wound, 15 minutes.	Sponge. $\frac{1}{2}$ oz.		Died 5 minutes after untoward symptoms set in.	P.M. Lungs and heart quite healthy.	Had taken CHCl_3 in larger quantity before.
55	13	M					Syncope.	
56	2		For removal of finger, 5 minutes.	On lint, 30 drops.				
57			For reduction of luxation of head of humerus.		P.	After the reduction was completed it was perceived that the P. at the wrist was gone. All the usual means resorted to in vain.	Syncope. No P.M. permitted.	
58		M	Cataract.			Operation had just been completed when patient was observed to change colour, and in spite of the use of galvanism and other nervous stimuli he expired.	Syncope. P.M. The heart was found in a very soft and fatty condition. No morbid sound had been heard previously by auscultation.	Had twice before been under CHCl_3 without bad effect.
59		F	For extraction of tooth.	Upon napkin, 50 minims in two doses.	P.	After extraction of tooth there was peculiarity in R. which almost at once ceased and on feeling at wrist there was no P. Artificial R. without effect.	Probably syncope characterised by spasm of left side of heart. P.M. Nothing abnormal. Left ventricle of heart firmly contracted, and cavities on left side empty; on right side auricle and ventricle moderately distended, and there was no clot.	Sitting up. The patient had taken a larger dose of chloroform on a previous occasion with no ill effect.
60		M	For avulsion of nail.	Handkerchief.	?			Patient an apparently healthy man.
61	12	M	To facilitate catheterising, 2 or 3 minutes.		P. & R.	Lips became blue, jugulars distended, P. and R. ceased. Fingers passed down epiglottis, deep inspiration, vein of neck opened and 1 oz. blood let, then another inspiration. Tracheotomy, artificial R., stimulation of diaphragm by induction apparatus, cold affusions, electricity to region of heart and acupuncture of heart. These measures revived action of heart for short while but it soon ceased.	Syncope. No P.M. account furnished.	Was suffering from œdema and albuminuria following scarlatina.
62								
63	11	M	Lithotomy.		P. & R.	P. and R. ceased at same moment.		
64		M	For reduction of dislocated thumb, 3 or 4 minutes.	1 dr.	P.	P. suddenly ceased beating, and in a moment patient was dead.		Patient strong and healthy. Was said to have been compelled to take CHCl_3 against his will.
65	15	M	For removal of necrosed bone from stump of amputated thigh.	2 to 3 dr.	?		P.M. Right side of heart loaded with dark-coloured blood, and lungs highly congested.	
66	20	F	For extraction of teeth.	Sponge, 1 dr. (in three portions).		After inhaling first two portions, three teeth extracted. Consciousness not lost. Remainder then given. Remaining teeth extracted. Sudden pallor; R. ceased, then P. Congestion of capillaries about neck and upper portion of chest; pupils dilated. Measures adopted were: External stimulation, artificial R. and galvanism for $\frac{1}{2}$ hour with no effect.	Syncope.	Sitting posture. Had taken CHCl_3 for extraction of 6 teeth 3 days previously.
67		M						
68	9	F	For strabismus.	$1\frac{1}{2}$ drs.	P. R.	Insensible and pulseless; breathed heavily at intervals. Pupils dilated and R. ceased. Artificial R. resorted to, but death took place in two hours.	Syncope. Cessation of R.	
69	8	M	For strabismus.			Died before commencement of operation.		
70		M	For operation about thigh.		P		Inhalation of chloroform.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
71	35	M	For removal of ligature after removal of diseased testicle. 5 to 7 minutes.	Towel cone. 1 dr.	P. & R.	After having passed into second stage, suddenly became stertorous, underwent spasm (opisthotonic) for about 1 minute, and ceased to breathe. Efforts to restore action of heart and lungs failed. Means employed were: Cold affusion, drawing out tongue, artificial R., ammonia to nostrils and heart, galvanism.	Syncope. Paralysis of heart. P.M. Kidney congested measured 7 inches in length by 4 in width, resembling larger red kidney described by Bright. Slight accumulation of fat over pericardium and on surface of heart. Brain effusion between dura and pia mater, and between latter and arachnoid. Cessation of heart's action may have been caused (1) by convulsion causing effusion on brain—convulsion due to blood charged with excrementitious matter; (2) overloaded blood charged with CHCl_3 acting on heart.	Had twice before taken CHCl_3 for removal of testicles, large doses, 2 oz. and $1\frac{1}{2}$ oz. On second occasion was suffering from "Dengue."
72	40	F	Examination of injury to elbow.	2 dr.	? R.	Before examination could be made, patient ceased breathing and died.	P.M. Heart, liver, and kidneys somewhat fatty. Lungs "hypostatic." ? Hypostatic congestion.	Patient was stout. Chloroform was carefully administered.
73	30	M	For operation for strangulated inguinal hernia. 25 minutes (abort).	Silk handkerchief. $1\frac{1}{2}$ drs.	R.	Vomited; fluid sucked into windpipe (apparently), struggled, and turned black in face. Position of patient changed, ammonia and other restoratives given, but death took place in very short time ("less than 2 minutes," according to one account).	Asphyxia.	
74	15	M	For operation on knee joint.		P.	After completion of operation, P. suddenly ceased to beat. Artificial R. for an hour and other means employed without effect.	Syncope.	
75	59	M	Lithotomy.	Napkin folded conically. More than 1 dr.		Operation just begun, for which little more CHCl_3 given. Patient made one or two R.s when condition became critical. Measures adopted were: Cold affusions, spanking, striking chest, pressing abdomen, laryngotomy for artificial R. All with no avail.		
76	45	M	For circumcision for ulcer on prepuce	Towel.	P. & R.	Lividity; cessation of P. and R. Measures adopted were: Drawing forward tongue, artificial R. (Marshall Hall's method) for $1\frac{3}{4}$ hours, ammonia to nostrils, galvanism through thorax and other parts.	? Syncope. P.M. Heart: $13\frac{1}{2}$ oz., walls bloodless, tissue easily torn, fatty degeneration; lungs intensely congested; liver fatty; kidneys congested; brain: effusion of blood on dura mater, little serum in lateral ventricle.	On last admission presented usual appearance of having been on debauch.
77	19	F	For removal of warts about vulva. $\frac{1}{2}$ minute.	In compress (quantity small).	R.	Exhibited symptoms of asphyxia. Restorative efforts used unremittingly without success.	Asphyxia.	Patient had taken CHCl_3 successfully three weeks before for same operation.
78	17	M	Removal of cystic tumour of neck.		P.	Patient seized with violent excitement, while large vein at bottom of cyst poured forth much blood. Deligation of vein difficult because of convulsions, but vessel having been secured and wound being dressed, and chloroform removed some minutes, P. at wrist stopped and patient died after artificial R. for $1\frac{1}{2}$ hour.	Syncope. M. Broca thought that air in veins caused death, but this not confirmed by P.M.	Patient found to have been subject to epilepsy.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
79			For ligature of external iliac artery for traumatic femoral aneurism.	Napkin.	P.	P. at wrist suddenly imperceptible, R. feeble, face purplish. Measures adopted were drawing forward tongue, cold affusions, ammonia to nostrils, electricity and artificial R. with no avail. Heart's action seemed to have stopped before R. entirely ceased.	? Syncope. P.M. Blood in veins and in heart quite fluid, almost black. Many bleeding points in section of brain and medulla oblongata. Pia mater congested. Other appearances healthy.	
80	65	M	Cancer of colon.				P.M. "Cancer of colon, chloroform, ileus, &c."	
81			Extraction of teeth.			After operation patient rallied for a while and then expired.	Syncope.	Sitting posture.
82	28	M	Amputation of finger.	Handkerchief. 1 dr. In 3 doses of 20 minims.	P.	Became violently convulsed and P. ceased.	Syncope. Convulsions. Fatty degeneration of heart. P.M. Tubercle at base of brain. Heart soft and fatty. Liver heavy and soft.	
83	12	F	Operation for necrosis of lower end of tibia.	Folded towel. 1 oz.	P.	Deadly pallor; twitching of muscles about mouth; eyes rolling up; pupils dilated; breathing stertorous; P. at wrist imperceptible. Measures adopted were—drawing forward tongue, applying ammonia to nostrils, pouring whiskey down throat, cold affusions. As heart's action could not be heard artificial R. (Marshall Hall's method) employed, with no effect.	Syncope. P.M. Heart healthy in texture, blood both sides, with few clots on each; right ventricle soft and flaccid, left, rigidly contracted. Lungs congested, right with black blood. At inquest most searching enquiry made.	Had taken CHCl_3 (1½ oz. used) four days earlier for exploration of sinuses. No untoward effects.
84	53	M	Tying vessels in cut hand.		P.	P. nearly imperceptible; lips pale; face livid; R. distinct though irregular. Tracheotomy performed. Artificial R. set up; result 2 or 3 hurried Rs., but no return of breathing or circulation. Artificial R. kept up ½ hour.	"Chloroform." P.M.	Hand had been cut with piece of broken porcelain, had been much hæmorrhage and patient very anæmic.
85	26	M					? Syncope. "Very violent spastic contraction of heart in subject weakened by loss of blood."	
86		F	Teeth extraction.				No inquest, coroner being satisfied that CHCl_3 had been administered properly.	"Sitting up."
87			Secondary operation on eye.				No inquest, coroner being satisfied that CHCl_3 had been administered properly.	
88			Operation on eye.					
89–90–92–93								
94								
95	35	F	Extraction of teeth.	Sponge. 2 dr. (hardly used).		After 3 or 4 inspirations R. ceased; no P. Artificial R. and stimulating applications to heart and extremities to no effect; 1 or 2 inspirations after bad symptoms appeared.	No P.M. allowed.	
96			For fistula.		?			
97			Removal of left eye-ball.		? P.		? Syncope. P.M. showed heart very diseased.	No symptoms of heart disease ascertained before administration of Chloroform.
98			Surgical operation.				Diseased state of heart.	CHCl_3 given with due precautions.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
99	38	M	For hæmorrhoids with external strangulation of prolapsed rectum.	Napkin. 2 dr.		Face somewhat livid, but P. and R. good, so operation about to be begun. Turned on right side; ceased breathing; P. both at wrist and carotids imperceptible; face dark livid. Placed on back, head lowered, cold affusions caused four long full aspirations, but no return of circulation. Artificial R. withdrawing tongue and elevating epiglottis.	"From sudden spasmodic contraction of heart, continuing till life extinct, this being effect of CHCl_3 on ganglionic nervous system." P.M. Venous congestion of brain, choroid plexus congested.	
100		M	For diseased bone in leg (3 minutes).		P.	Had not inhaled more than 3 minutes when P. ceased and death ensued.	Paralysis of heart. Death attributed largely to effect of fear.	Heart and lungs were carefully examined before administration; was nervous about taking CHCl_3 .
101	40	M	Amputation of thigh for inflammation of knee-joint.	Towel.	P. & R.	Operation performed, breathing good, P. strong. In 3 or 4 minutes teeth became clenched, R. stertorous, P. small, skin with clammy perspiration. Measures adopted were forcing open jaws, drawing out tongue, artificial R. stimulants, but patient died 10 minutes after first alarming symptoms.	P.M. All organs healthy, but pale from want of blood. Diseased joint examined; synovial membrane converted into gelatinous mass. Heads of tibia and fibula completely destroyed and bones roughened.	
102	33	F	Extraction of stumps of teeth.			After 8 or 9 teeth had been removed, livid expression came over patient's face, and she seemed sinking. All usual means used for resuscitation—such as galvanism, stimulants, artificial R. &c.	Death from a state of brain induced by inhalation of chloroform, "in reference to which more than usual precautions had been taken."	
103	52	F					P.M. "Disease of heart: chloroform."	
104	52	F	For applying nitric acid to wounds of tumours on knee.	Skinner's inhaler. 2 dr.		Patient died instantly without warning, immediately after muscular action. Measures resorted to were artificial R. (Marshall Hall's method, and Sylvester's method) and galvanism. The last caused diaphragm to act twice with 2 inspirations; but no further signs of life returned.	? Syncope. No P.M. allowed.	Patient was suffering from a tumour on each knee the size of an orange, originally inflamed bursæ.
105	50	M	Castration (3 to 4 minutes).	On lint. 15 to 20 drops.	P.	After the first dose of 20 drops had been given and another was about to be administered P. ceased. Restorative measures instantly resorted to were:—Ammonia, electricity, Sylvester's method of artificial R., Phlebotomy on elbow (from which 1 oz. dark red blood flowed). Meanwhile hypostatic congestion set up along back and sides.	Syncope. P.M. Fluid black blood from preliminary incision and from vessels of brain. Dura mater adherent to calvaria and pia mater, and arachnoid of opaque white colour. Heart little larger than usual, with little more fat than normal, and little fluid blood of dark red colour in chambers.	
106		M		Handkerchief. 2 dr.	P.	P. suddenly subsided, extreme pallor. Patient was given sherry, and other means adopted.	Action of chloroform on weak heart. ? Syncope. P.M. Enlarged heart with thin muscular walls.	Nothing before administration to contra-indicate use of chloroform.
107	30	M	Amputation of portion of hand.		P. & R.	After 6 inspirations breathing became difficult and stertorous. P. ceased. Artificial R. and other means tried, but death shortly took place.	"Paralysis of heart" (probably).	
108	40	M	Reduction of dislocation of head of humerus.	Sponge.		Immediately the dislocation was reduced face became livid and death took place. All means employed for resuscitation.	? Asphyxia. Patient was reported by his physician to have died of apoplexy.	
109	12	M	Reduction of dislocation of hip (20 minutes).	Handkerchief. 2 dr.	P.	During operation P. failed and patient died at once.	? Syncope.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
110		F	Extraction of teeth.		R.	When extraction of teeth over, patient stopped breathing; was laid on floor and artificial R. tried with no avail.	? Syncope.	Sitting posture. Had already taken CHCl_3 twice at the same sitting.
111			Amputation of leg.			Patient died about a minute after CHCl_3 had been given.		
112		F	Extraction of teeth.		P.	"After extraction of teeth" patient went into spasm or convulsion, and limbs became rigid. Was placed on lounge; reclining; whole muscular system relaxed, P. ceased and after gasping a few times suddenly died. Diligent but unsuccessful attempts at resuscitation.	? "Nervous shock or CHCl_3 , or both combined."	Sitting posture. Patient was advised to do without CHCl_3 but insisted upon CHCl_3 or ether being given.
113	25	M	Amputation of finger.	Quantity small.			P.M. Heart: right auricle fatty? Spleen ruptured and blood in peritoneum.	Patient very nervous. Usual precautions taken, and heart found normal, but if fatty degeneration as stated by medical witness careful examination would have detected it. Death might have happened from impure CHCl_3 . The reporter insists that it would have been discovered whether impure CHCl_3 caused the death, by application of the acid test.
114		F	For relief of prolapsus uteri.				P.M. Nil, except slightly flabby heart.	Death might have happened from impure CHCl_3 . The reporter insists that it could have been discovered whether impure CHCl_3 caused the death, by application of the acid test.
115							P.M. Heart diseased, but no particulars given.	
116	?	?		Lint cone.	P.	P. stopped suddenly and all efforts to restore animation unavailing.	P.M. appearances nil, except large and flabby heart.	CHCl_3 pure.
117	39	F	Removal of malignant fungoid growths from gums and lower jaw by galvanic cautery (13 minutes).	Skinner's flannel mask.	P.	On the third introduction of the heated wire patient instantaneously expired. Battery at work applied to chest; month to month insufflation and Silvester's method tried with no effect.	Syncope, probably secondary to mechanical interference with respiration. P.M. Large goitre on neck; bloody mucus occupying larynx and trachea; heart cavities all empty; lungs pallid and emphysematous.	Accemic.
118	37	M	For caries of ankle joint, preparing for amputation.	Folded towel.	P. & R.	One minute after first inspiration convulsive movement of extremities. CHCl_3 removed, head declined. After 4 or 5 convulsive inspirations ceased breathing; face livid; pupils dilated; eyes and jaws open; heart's action maintained for 40 minutes.	? Syncope.	
119		M	For hæmorrhoids.			When everything ready for operation, patient died.	? Syncope. P.M. Heart exceedingly fatty. Liver far advanced in cirrhosis. Spleen with multiple abscesses.	Had been suffering from variety of symptoms referable to intemperate habits.
120		M	On wrist.					Had on two recent occasions undergone same treatment.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
121	30	M.	For diseased bone.	On lint. 1 dr.		When only partially under influence of anæsthetic, death suddenly took place. Every means for resuscitation used without avail. Tongue drawn forward; artificial R.; galvanic battery over heart and neck and diaphragm. Artificial R. for $\frac{1}{2}$ hour. Right jugular vein also opened.	? Syncope. P.M. Degeneration of muscular fibre of heart, endocarditis shown by roughening of mitral and aortic valves. General congestion of viscera.	No symptoms during life of cardiac disease or clue to cause of heart disease.
122	21	M.	Reduction of dislocated hip (20 minutes).	2 dr.	P.	P. failed and patient died immediately.	Syncope.	
123		F.	Extraction of teeth.					Sitting posture.
124	14	M.	For necrosis of tibia.		P. & P.	Operation was commenced when patient was seized with vomiting. Breathing ceased and P. became imperceptible. Usual measures taken for resuscitation.	Syncope. P.M. appearances nil, except enlarged liver.	
125	26	M.	Insertion of drainage tube in thigh for disease of neck of femur.	On lint. 1 dr.	P. & P.	R. ceased. Face pale at first and shortly became livid. Artificial R. (Silvester's method), tongue pulled forward, and battery.	Syncope. P.M. Lungs dark red and large bronchial tubes full of thin frothy fluid. No clot in pulmonary arteries; heart large, with only shred of de-colourised clot in left ventricle. Wall of left ventricle thicker than natural and cavities generally large. Heart 14oz. Bits of wall of left ventricle showed granular degeneration; striæ obliterated. Endocarditis on aortic valves.	The commencing fatty degeneration of heart sufficient to account for chloroform being fatal.
126	68	M.	Amputation of foot.	1 dr. (about).	P.	Suddenly became rigid and P. stopped. Every exertion made for restoration; artificial R. for $\frac{3}{4}$ hour with no avail.	? Syncope.	
127	42	M.	To quiet tetanic spasms after fracture of both legs.		P.	After few inspirations P. ceased. Artificial R. and drawing out tongue resorted to. Soon circulation and R. restored; but after being put to bed R. ceased and life became extinct.	? Syncope.	
128	22	F.	Ovariectomy.	On towel.		Patient vomited suddenly and profusely. Immediately eyes opened, pupils preternaturally dilated, face became pallid and R. affected. Measures adopted were: Artificial R. and pulling forward of tongue. Deep spontaneous R. several times in succession, but death followed on a second collapse.	? Inhalation of chloroform causing syncope; but in this case great doubt as to whether syncope was not caused by operation itself (see L. 25 Feb. 1870, pp. 297-299). P.M. No diseased conditions in head or chest, or elsewhere. Ovarian tumour free from peritoneal adhesions.	Patient thin and emaciated.
129		F.	For opening of whitlow.	3 dr.				
130		F.	Removal of epithelioma of tongue.	(1) Coil of paper; (2) napkin.		Suddenly fainted, and despite all efforts made for a long time never breathed again.	Direct poisoning of nervous centres by CHCl_3 .	
131	6	F.	For convergent strabismus of left eye.	2 dr.		Operation performed while patient not fully under CHCl_3 . Patient was restless; shortly after operation ceased breathing. All efforts to restore R. futile.		
132		M.	Amputation of forearm.		P.	P. became weak; R. ceased, and after one or two respiratory efforts patient died.	P.M. Blood very fluid; right auricle and right ventricle enormously distended; advanced fatty degeneration of heart.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
133		M	Amputation of left leg crushed by railway engine.		P.	Anæsthesia induced almost instantly: P. became slow and irregular, breathing irregular. Symptoms improving, operation was performed. Again P. failed with spasmodic gasping breathing. Artificial R. tried, with no effect.		Patient intoxicated when leg crushed, but being a stranger his habits of life were not known.
134		F	Reduction of dislocated shoulder.	2 drs.		Took CHCl_3 well, but ceased to breathe soon after.	Organic disease of heart.	"Was a stout woman with good colour."
135	24	F	Forcible extension of knee.		P. & R.	As symptoms of asphyxia appeared the operation could not be continued. Artificial R. restored breathing for 1 minute, but it again became irregular, and P. became imperceptible. Tracheotomy, venesection and electropuncture tried with no effect.	? Syncope or asphyxia. P.M. Small vegetations on valves of heart. It is to be noted that P. became imperceptible before R. stopped.	
136			Fistula in ano.					
137								
138								
143								
144								
145								
146	30	F			? P.		Syncope.	Had been given CHCl_3 a week before, but it did not take effect.
147		M	Amputation of thigh.	Clover's apparatus.	P.	Two minutes after cessation of giving anæsthetic, patient became faint and sick; heart ceased to beat.	Death not directly due to administration of chloroform, but rather to shock acting on feeble heart in very unhealthy subject.	Patient strumous and anæmic. Chloroform given with greatest care and stimulants given before its administration.
148	36	F	Extraction of 12 teeth.	Napkin.		After extraction of first 4 teeth patient became partially sensible, so small doses more given at intervals till all extracted. While retching or vomiting patient seemed to strangle, and suddenly expired. Was placed horizontally, and artificial R. kept up $\frac{1}{2}$ hour.	Asthénia of heart. P.M. appearances <i>nil</i> .	Had taken CHCl_3 well two years previously. Sitting posture.
149	42	M	Sounding for stone.	Clover's inhaler.	P. & R.	Some stertor, which passed off when put in position. When sound introduced R. suddenly stopped during inspiration, and P. could not be felt. Face became dusky pale. Artificial R. for 20 minutes and galvanism over præcordia tried. Pupils not noticed.	? Syncope. P.M. Heart: moderate amount of dark blood in right side, little in left, organ loaded with fat which penetrated deeply into substance, walls pale and soft, much interstitial fat and fatty degeneration of fibres. Some atheroma of aorta. Kidneys congested and albuminoid. Bladder contained pyramidal stone impacted in neck. P.M. "Poisoned by chloroform."	Had stricture of urethra and stone in bladder. Was unable to retain urine for more than five minutes and could get no sleep from pain.
150	34	M	Fracture of leg.					
151		M	Removal of cystic tumour over left eye.		P.	Operation nearly completed when patient threw back head, neck became stiff, and he gasped. Efforts made to restore him for $\frac{1}{2}$ hour with no effect.	Paralysis of heart.	
152	34	M	Amputation of finger (3 or 4 minutes).	Lint.		After inhaling the drug 3 or 4 minutes he expired.	"Death from tetanus, accelerated by chloroform."	
153	40	M	Surgical examination.			Died suddenly.		
154	28	M	Fistula in ano.		R	When the operation had been completed, patient placed on his back. Breathing ceased and he became livid in face. Heart continued beating though feebly. After artificial R. had been employed a few minutes he breathed a few seconds, and then breathing and P. ceased altogether. Artificial R. for 40 minutes without effect.	Inhalation of chloroform. Failure of R. soon followed by that of heart. P.M. Heart 14 oz., left ventricle full of dark fluid blood, its walls pale and flaccid and covered with	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
155	56	F	Fractured jaw.				only a thin layer of fat. Mitral orifice admitted tips of four fingers. Muscular fibres of heart with abundance of fat globules. Lungs congested, pulmonary artery full of blood. Spleen large and soft. P.M. "Chloroform. Fatty heart."	
156			For dislocated humerus.					Heart and lungs carefully examined before operation.
157	52	M	Iridectomy.	In flannel cone. $1\frac{1}{2}$ dr.	? P.	After a drachm of CHCl_3 had been given operation commenced, but as pain was observed 20 minims more given. Operation completed when suddenly stertorous breathing began, lips and face turned blue and sterno-mastoids became contracted. Cold water and artificial R. (Silvester's method). R. returned. But lividity came back and veins of neck and temple were swollen. Artificial R. and battery and frictions maintained for 1 hour, but the heart ceased to beat.	Inhalation of chloroform causing direct paralysis of heart. No P.M.	
158		F	Amputation of foot.		R.	R. ceased. Died suddenly. No stertor or gasping.	"Paralysis of heart." P.M. Fatty degeneration of heart. "Not enough to account for death." ? Syncope. P.M. failed to exhibit any peculiarity.	
159	11	M	Iridectomy and removal of lens.	2 dr. (about).	P. & R.	While the dressing was being applied the lad made several deep inspirations and then ceased breathing. P. could not be felt. Other pupil much dilated. Artificial R. and other means succeeded in temporarily restoring the P. and colour and a few respiratory movements, but further collapse set in and after $\frac{3}{4}$ hour of further effort hope was abandoned.	P.M. failed to exhibit any peculiarity.	
160		M	For reduction of dislocation of shoulder joint.	$1\frac{1}{2}$ oz. (about).	P.	After 1 ounce CHCl_3 given, more CHCl_3 sent for, patient meanwhile recovering. After second dose from second bottle spasm and cessation of heart's action came on—then sudden death.	"Death from the effects of chloroform administered without proper degree of care." (Verdict of Coroner's Jury.) M. T. & G. "correctly" claimed that this was "moustrous," as CHCl_3 accidents happened with the most experienced surgeons.	
161		F	Extraction of tooth.			Died 5 minutes after extraction of tooth.		Was in perfect health
162		F	Extraction of tooth.		R.	Difficulty of breathing came on about $1\frac{1}{2}$ hour after operation, and no restorative measures were of avail. It was significant that the blood coagulated almost immediately after operation, and that there was no hæmorrhage.		Sitting posture. Had taken CHCl_3 well twice before.
163		M	For perineal abscesses and fistula.	Lint cone.	P. & R.	More violent than usual during second stage; CHCl_3 discontinued and operation begun. Was turned on left side, when suddenly breathing and P. ceased. Tongue held and artificial R., cold water douche, application of ammonia and other methods tried. Of some avail for short time, but breathing ceased.	Paralysis of heart. P.M. All organs healthy, but immense amount of fat.	
164		M	Amputation of leg.	On lint. 3 dr.		Before operation commenced, and after inhaling the CHCl_3 , he became excited with spasm and rigidity; P. became rapid and feeble, but heart still beat. Galvanism from neck to diaphragm and artificial R. practised. Consciousness partially restored; R. feebly re-established and P. returned at wrist; was able to swallow a little brandy, but died soon after.	Sank through depression of vital power caused by hæmorrhage and injury.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
165		M	For forcible extension of ankylosed knee joint.	1½ dr.		Unconsciousness supervened and patient died in about $\frac{3}{4}$ hour.		Had been given CHCl ₃ several times for over a week preceding operation.
166		M	For reduction of dislocation of right shoulder.		P.	While dislocation was being reduced by means of pulleys, patient suddenly ceased to breathe. Water dashed in face; tongue pulled forwards, artificial R., and galvanic battery applied; 3 or 4 faint respirations obtained, but heart did not beat again.	Syncope. P.M. Heart flabby, in folds, not contracted; muscular fibres fatty, veins and liver much congested.	
167	50	M	For putting leg with dislocated tibia and fractured fibula in swing apparatus (4 minutes).	Handkerchief. Less than 1½ dr.	P. & R.	Limb was about to be raised from splint when dangerous symptoms appeared. Artificial R. for 40 minutes restored heart's action and breathing, but both soon ceased, and no efforts to arouse them availed.		
168	49	F	Amputation of ulcerated leg.		P.	Just before insensibility came on patient became suddenly livid. P. ceased; 1 or 2 gasps. Artificial R., cold water sprinkling and flipping, and small quantity of blood drawn from jugular vein. 1 or 2 gasps, probably death throes. Retinal veins much distended.	"From blood being unable to pass through lungs." P.M. Lungs dark red, very little blood escaped from tissues when pressed. Patches of collapse in both. Heart: right side healthy, largely empty because veins of neck had been divided and blood had escaped. Left ventricle with very little blood, its muscle pale and soft, showing fatty degeneration, but no yellow lines across muscle.	Had been suffering from syphilitic ulceration of leg. Had taken CHCl ₃ well a week previously, but vomited for 3 days afterwards and had 2 rigors. Had to be given food by enema.
169								
170	39	F	Extraction of 8 teeth.	Napkin.	P.	Anæsthesia partial; when tooth extracted patient screamed loudly; fainted, was laid on lounge. P. and heart action ceased, and R. at length failed. Measures resorted to were: Artificial R., electricity, cold water and stimulating enema.	? Syncope. No P.M. reported.	Sitting posture. Of delicate health, very nervous, mother of 8 or 9 children. Had taken CHCl ₃ in all her labours except the last, and the same for teeth extraction on 3 different occasions previously to fatal dose. Opinion expressed that if CHCl ₃ had been pushed to insensibility, the case would have ended differently.
171		F	Extraction of tooth.	Cone made from handkerchief. 3 dr.	P.	Deathly pallor came over countenance. Heart ceased. Artificial R. by mouth to mouth inflation for 1 hour. Anæsthesia was only partial.	Syncope.	Sitting posture. Nervous; delicate; no organic disease.
172		F			P. & R.	Had fair P. and regular R. up to very instant when both ceased.		
173		F				Died on 6th day from vomiting caused by first inhalation of CHCl ₃ .		
174								
175								
182								
183						In a few of these cases death was gradual.		
184		M	For wound left by amputation dressing.	Less than ½ oz.				The first death after a long and frequent use of CHCl ₃ . Had taken CHCl ₃ twice latterly—viz., 3 days before and on the day before his death.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
185	5	M	Dressing external burn on dorsal and lumbar regions.		R.	After inhalation had been discontinued breathing had ceased. Measures employed were: Artificial R. (Silvester's method) and galvanism of diaphragm through phrenic nerve. A few gasps accompanied the galvanism at first. Artificial R. continued for $\frac{3}{4}$ hour.	? Failure of respiration. P.M. Blood dark-coloured. Small clot in right ventricle, left contracted. Left lung firmly adherent to upper lobe of pleural costa; in lower lobe lobular collapse and some emphysema; lining membrane of trachea congested and swollen; in minute bronchi rusty-coloured, frothy mucus.	The wound would not heal, and general health of patient was bad.
186	45	M	Amputation of middle finger for necrosis.	3 dr.	P. & R.	Patient hardly under influence of drug when he died suddenly. No alteration noted in breathing till face became pale, and heart's action almost immediately was arrested. Measures employed were: Artificial R. and galvanism.	Syncope. P.M. Heart fatty.	
187	37	M	For radical cure of hernia.	Towel.	P. & R.	P. and breathing suddenly ceased. Measures taken: Trunk, head, and neck laid straight, tongue drawn out, artificial R. (Silvester's method), ammonia to nostrils, galvanism, cold affusions, vein on arm and jugular vein opened. Treatment for $\frac{1}{2}$ hour; no return of life.	Mixed causes— CHCl_3 inhalation; dread of operation, diseased condition of heart. P.M. Heart-walls slightly flaccid; blood thin and frothy; walls of left ventricle and septum cordis fatty. Lungs healthy, but deeply loaded with dark fluid blood. Kidneys partially fatty (<i>B. M. J.</i> 1871, ii. p. 130) Much blood on right of heart compared with quantity on left contra-indicates death from gradual asphyxia.	Moderately stout; said to be intemperate.
188	13	M	On eye for squint.			When operation completed and patient was recovering from effects of drug, he tried to vomit, while so doing he made a deep inspiration which forced back the rising matter and caused suffocation.	Asphyxia.	Patient taken to hospital for treatment of an internal disease.
189	34	M	For reduction of fragments of fractured leg.	Rag.	P.	Anæsthesia was incomplete; operation unsuccessful; P. ceased beating; usual methods tried with no effect.	From shock to dilated heart. P.M. Fatty degeneration of liver and kidneys. Brain softened. Heart flabby and much dilated.	Powerful man; seemed intemperate, but no trace of alcohol in stomach.
190	33	M	Amputation of first and second toes of left foot.					
191		F		Not more than 1 dr. used.				
192	48	F	On knee.	Less than 1 dr. used.				
193	31	F	Extraction of tooth.	$\frac{1}{2}$ oz. used.				Sitting posture.
194			For dislocation of elbow.					
195		M	Amputation of crushed toes.		P.	Almost immediately became violent. P. weak and then ceased. Operation had not commenced before fatal symptoms occurred. Galvanic battery applied.	? Syncope.	
196	45	F		1 dr.		After one drachm had been used signs of depression began to develop themselves, and death occurred.	Syncope.	
197	49	M	On diseased elbow.	Less than 1 dr.		Died after taking one or two inhalations of a drachm of CHCl_3 which had been poured on a sponge at least two or three minutes before.		

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
198	32	M	Removal of tumour at edge of sternomastoid.		P.	Complete resolution was produced, and the first incision had hardly been made when the patient was found to be colourless and without P. or sounds of the heart. In spite of all efforts he died.	P.M. A small vein leading into the external jugular was found to have been obliquely opened. The jugular contained a long clot segmented by some bubbles of air. Other bubbles existed in the mediastinal and post-cardiac veins. The right ventricle contained a notable quantity of air, and some small ecchymoses were the only things remarkable to be observed in the lungs.	Patient had successfully taken chloroform 6 weeks previously.
199	26	F	For iridectomy for artificial pupil.	Inhaler with lint. 3 drs.	P.	Violent struggle began, when P. quickened and then became imperceptible; face changed from crimson to livid purple. Patient was rolled on to left side and back again. R. did not stop but became shallower. R. aided by artificial R. kept up 25 minutes. Interrupted magnetic current applied over phrenic nerve, and enema of brandy and cold water given. Action of heart not restored. Acupuncture between fifth and sixth ribs also tried.	Paralysis of fatty heart. P.M. Anterior surface of heart covered with layer of fat; muscular walls thin, pale, soft, flabby. Cavities dilated; right containing fluid blood, left empty. Lungs engorged with dark blood.	
200	46	F	For ovariectomy.		P. & R.	Breathing laboured, face livid, P. failed; effort to cough, with discharge of frothy bloody mucus. Measures resorted to were: Drawing out tongue and artificial R. (Sylvester's method). These failing, it was found that metal plate with false teeth was impacted in the larynx. This was extracted, and artificial R. continued 40 minutes. Some gasps, but heart failed.	Asphyxia—secondary heart failure. P.M. Heart: thin walls and flabby; right ventricle dilated containing small quantity of fluid blood; mitral and aortic valves slightly altered by deposit; no fatty degeneration. Lungs healthy. Abdomen: enccephaloid cancer of peritoneum with ovarian cancer.	
201	48	M	Removal of lenses of eyes.	Fowl. More than 1 dr.	P.	Jerked head off pillow. On being raised, breathing became interrupted and heart's action ceased. Measures resorted to were: Pulling forward tongue, cold water affusion, galvanism to phrenic nerve by Stöhrer's battery. Artificial R. for $\frac{1}{2}$ hour. Result, only a few shallow inspirations.	? Syncope. P.M. Body well nourished. Heart: hypertrophied and fatty; right cavities gorged with blood; no valvular lesions. Lungs emphysematous.	Thickset; met with injury through explosion of blasting powder. Had taken CHCl_3 once before for operation on eyes.
202	19	M	For phagedenic sore.		P.	Before patient fully under P. ceased. All efforts including galvanism and artificial R. of no avail.	? Syncope. P.M. Extensive fatty disease of heart.	
203		F			P. & R.	P. and breathing ceased suddenly after a few stertorous Rs. Usual means resorted to, including galvanism which "produced some convulsive efforts of the respiratory muscles," but animation not restored.		
204		M		1 dr.	P. & R.	After short inhalation a few convulsive Rs. and then sudden stoppage of heart's action and breathing. Galvanism, artificial R. and tracheotomy tried without effect.	Paralysis of heart.	
205	36	M	On jaw-bone.			Expired 2 minutes after administration.	Paralysis of heart.	
206			On hip joint by galvanocautery.			Breathing became stertorous. Tracheotomy instantly performed with other measures, but all of no avail.		
207			Amputation of thigh.			Patient died on table before operation had commenced.		Strong and healthy looking.
208	35	F	Repair of a bitten-off nose.					

SERIES B.
DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
209	24	M	On eye.		P.	Became apparently unconscious so that inhaler was being removed, but on showing signs of sensibility it was re-adjusted. A change seen and heart soon ceased acting. Measures taken to restore animation but without avail.	"Chloroform. Meningeal apoplexy." P.M. ? Syncope.	Had taken CHCl ₃ for similar operation previously.
210	16	F						
211-214								
215	70	F	Reduction of fractured leg.	Small quantity.		Patient quickly succumbed to influence of CHCl ₃ . Death ensuing when very little had been used.	"We are not aware that any necropsy was made or inquest held."	
216	34	M	Examination of inflamed foot and leg.	3 dr.	P.	P. failed; sighing, pallor, and some lividity. Measures adopted were: Artificial R. (Silvester's method), galvanism to heart, frictions and brandy enemata, abandoned after 3 hours. Operation was being proceeded with when P. failed.	Syncope. P.M. Lungs and pleurae healthy; lungs apparently, but not really, congested. Heart: pericardium healthy; left ventricle neither firmly contracted nor perfectly flaccid, with no excess of blood; muscular fibres somewhat degenerated. Stomach: extravasation of blood at œsophageal end. Liver: large, palish red. Kidneys: healthy, large, and venously congested.	Hard drinker. Tall, somewhat slender, fairly developed; body fairly nourished. Had taken no food for 3½ hours before administration of CHCl ₃ , but had some beer about 4 hour beforehand.
217		M	Amputation for compound comminuted fracture of left leg.	3 dr. 10 min.		Vomited twice during induction of anæsthesia. During operation, face became livid, tongue was thrust between the teeth, and R. ceased, which was restored on removal of tongue by forceps. To complete operation little more CHCl ₃ given (10 minims), which was inhaled for few seconds. Ten minutes after removal of mask R. shallow and infrequent, then patient became livid, teeth fixed, and R. ceased entirely. Galvanism and artificial R. used with no effect.	P.M. Heart pale and empty; mitral valve thickened, some atheromatous deposit in aorta; striae of muscular fibre distinct. Lungs congested.	
218	57	F	Removal of tumour from right breast.	1 dr.	P.	P. suddenly stopped. Breathing became short and shallow, then ceased; face livid pupils slightly contracted. Measures adopted were: Throwing open window, cold affusions, drawing out tongue with forceps, artificial R. (Silvester's method); but all useless.	? Syncope. No P.M.	Of active habits, temperate, and in good general health.
219		F	Extraction of teeth.			Patient became faint and in spite of every effort to revive her died in a few moments.	Syncope.	Sitting posture.
220	49	M	Re-setting of broken leg.		P.	Before leg could be re-set heart suddenly stopped. Usual means, including artificial R., resorted to with no effect.	Disease of heart. P.M. Heart and lungs diseased.	Intemperate. Leg had already been set, but patient displaced it in fit of delirium. Was very violent, and was suffering from spasms till the CHCl ₃ was given.
221	28	M	Amputation of thumb.	Napkin.		In a few minutes after administration patient began to struggle a little; face became suffused, eyes seen to "turn up and jerk." Tongue drawn forward. Breathed very heavily for 10 or 15 minutes. After this consciousness never regained. Galvanic battery sent for, none at hand.	? "From rupture of blood vessel on brain." "There would probably be some disease of the kidneys." No P.M. reported, or P.M. appearances detailed.	Patient was willing to have operation done without anæsthesia. No second medical man in attendance till just before patient died.
222	35	M	Removal of necrosed bone or amputation of leg at thigh (5 minutes).		P.	Had inhaled CHCl ₃ for about 5 minutes, when signs of distress came on, and violent struggles to push inhaler from mouth, then sudden cessation of heart's action, sudden gasping for breath, brief struggle—death. Measures resorted to were: Artificial R. and galvanic battery.	? Syncope.	Health had failed very much from diseased leg, and amputation was held out as only likely remedy.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
223	49	M	For diseased elbow.	Sponge. 1½ dr.	P.	Died after taking 1 or 2 inhalations of 1 drachm of CHCl ₃ .	Sudden syncope.	Had been drinking excessively for six weeks before injury.
224	51	M	Reduction of Pott's fracture (2 minutes).			Breathing became very full and slow, not stertorous; no P, no heart beat; pupils dilated. Measures resorted to were: Wet towel, opening jugular vein, application of magneto-electricity to cardiac region and artificial R. for 20 minutes. No return of P. but several respiratory attempts.	Syncope. P.M. Lungs: adherent by old adhesions; emphysema along anterior border and apices of both. Heart: small, right ventricle dilated, and with anricles full of black blood; walls of right cavities thin; left ventricle contracted and empty; coronary arteries slightly atheromatous; excess of fat on surface of heart. Liver large and in early fatty state.	
225	32	M	For injuries to foot.		P.	Became violent. P. weak, then ceased. Galvanic battery applied, to no purpose.	From overdose of CHCl ₃ causing paralysis of heart. No P.M.	Was not examined prior to administration of CHCl ₃ . Student had charge of P. An action was brought by patient's widow against the medical men. Finding—for the defendants.
226	15	M	Examination of necrosis of right humerus.	1 or 2 dr.	P.	Examination was concluded, and in recovering consciousness patient vomited greenish fluid. P. hitherto good, suddenly stopped, pupils dilated. R. impeded. Measures tried were: Artificial R. and galvanism for 1½ hour.	Syncope during recovery from CHCl ₃ . P.M. Some parts of heart and kidney put aside for examination, but viscera generally healthy.	Was the subject of fever from simultaneous necrosis of right humerus, left thigh, right tibia and metatarsal bone 4 months previously.
227	30	M	Forcible dilatation of sphincter in fissure of anus.	On two small linen compresses in metal cone with 2 air holes.		Patient did not take CHCl ₃ well, it was therefore given slowly. After dilatation was accomplished, patient showed signs of feeling pain. R. became noisy. Chest struck with palm of hand. At this moment eyes were wide open, immovable, without expression, breathing ceased and face was cyanosed. Artificial R. (Silvester's method) practised, the air entered left chest but the eye glazed and P. ceased. Artificial R. also performed by introducing sound into larynx but former method again resorted to. Battery applied to sides of chest and to epigastrium and also to base of neck. Muscular contractions obtained, which gradually diminished and then ceased.	? P.M. Made following day. Heart: engorged with blood, especially right auricle, which was almost as large as the fist. Walls intact, valves healthy. Blood in cardiac cavities fluid and black without clots. Left lung: two tubercles at apex as large as a nut, with softened interior; at top of lower lobe of same lung, large tubercle, around which there was slight hæmorrhage.	Patient of good constitution and robust appearance.
228		F	Extraction of tooth.	Napkin.		Artery flickered; pallor. Measures adopted were: Inversion; pulling forward tongue; application of ammonia to nostrils; cold douche—result of these several inspirations, after which breathing ceased. Artificial R. (Marshall Hall's method) and inflation of lungs by bellows; unsuccessful in restoring heart's action.	No P.M.	Sitting posture.
229	12	M	Extraction of tooth.					Sitting posture. 'Patient was suspected to be suffering from some heart trouble.'
230			Trivial.			Every means was applied to restore animation without avail.		Patient was young and robust.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
231	60	M	Introduction of catheter owing to rupture of perineum (more than 7 minutes, which was duration of 2nd administration).	Clover's apparatus.	P.	7 minutes after second administration commenced, P. flickered and stopped. Restorative measures of no avail. Measures taken were: Artificial R. (Silvester's method) for $\frac{1}{2}$ hour, galvanism to phrenic nerve and diaphragm, friction to extremities.	Syncope. P.M. Lungs deeply congested. Right side of heart flaccid and full of fluid blood; left side empty and contracted. Arteries in brain and throughout body atheromatous. Blood infiltrated into cellular tissue of perineum and scrotum.	Patient an insane criminal.
232	45	F	Putting fractured arm upon splint and reduction of dislocation of radius.	2 dr.	P. & R.	Violent struggling at first, but after the second draught was given the patient ceased struggling and operation had begun, when patient's face was noticed to be livid, pupils dilated. P. and R. ceased. Patient was laid on floor, tongue drawn out with forceps. Galvanic battery applied to phrenic nerve and diaphragm. Vein in arm opened and artificial R. performed for $\frac{1}{2}$ hour, but the patient did not respond.		Patient not noted for sobriety.
233	22	F	Tracheotomy.				P.M. "Death by chloroform."	Was suffering from phthisis and tubercular laryngitis.
234		M	Amputation of leg and part of thigh for fracture in both.		P.	In the middle of the operation, which was very protracted, patient began to struggle and became conscious. More CHCl_3 given, at once P. gave way, patient gasped and was dying. Measures taken were: Admission of cold air, drawing forward tongue with forceps, attempt at artificial R. (Silvester's method)—these measures too late.	Syncope. Although death was due immediately to CHCl_3 , everything had happened previously that could hasten it. (1) Patient had suffered injury in coal mine, which caused most serious fractures; (2) Six hours had elapsed between accident and operation; (3) He was carried four or five miles on stretcher, over bad road, in wet clothes, losing much blood and suffering great pain. Case not recorded at the time, because it was generally thought that the injuries caused death, and not the CHCl_3 .	The medical man recording this case insists on the necessity of providing proper room and beds at all large works where accidents so often occur, which would double the chance of recovery, even when anæsthetics, with their necessary risk, have to be given for an operation.
235		M	For injury received in mine.					Patient an injured miner. Delay and loss of blood had taken place.
236			For strangulated hernia.					
237	30	M	Removal of diseased tibia after compound comminuted fracture of both bones of right leg (1 minute).	Lint. 1 dr.	P.	Patient went under easily, and as first incision was made P. suddenly failed and stertorous breathing ensued. Cold water was dashed on face. Ammonia applied to nostrils. This roused him for about a minute and the R. became easy, when syncope again occurred, from which he did not rally. Means employed: Ammonia to nostrils, turpentine stupes to heart, artificial R. (Silvester's method), galvanic current to respiratory muscles, tongue drawn forward.	P.M. Lungs anteriorly natural, posteriorly portions were infarcted. Trachea and bronchial tubes were infarcted. Heart slightly larger than natural. Muscular tissue somewhat flabby. In right ventricle there was a small patch of organised lymph about size of four-penny piece. Liver, spleen and kidneys healthy. There was an unusual amount of fat in the abdomen.	A strong muscular soldier. General health good.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
238		M	On machinery wound of finger.			Before full narcosis was established, patient was seized with convulsions and died.		Apparently healthy.
239	42	F	Extraction of tooth.	Conical sponge.	P.	Coincidentally with extraction of tooth, P. stopped. Artificial R., dashing of cold water, and faradism, did not restore animation.	Syncope. P.M. Heart: fatty degeneration; muscular structure of tawny colour, easily broken down under pressure; microscopically, only one thick line of healthy muscular structure beneath visceral pericardium, the rest in advanced fatty state.	Sitting posture.
240	37	M	Puncturing enlarged liver.		P.	P. suddenly failed; patient turned blue and gasped. Artificial R. and galvanism employed without success for 1 hour. Artificial R. rather embarrassed as patient on bed in corner of ward.	Syncope. P.M. Liver greatly enlarged, lardaceous, containing numerous gummatous masses, closely adherent to diaphragm.	
241	29	M	Amputation of thumb (5 minutes).	$\frac{1}{2}$ oz.		5 minutes after commencement of administration was convulsed, skin of chest, neck and face became purple, and breathing stertorous. Breathing ceased. Artificial R. and galvanism resorted to. Efforts abandoned after 20 minutes.	Chloroform and alcoholism. Died from <i>coma</i> , at infrequent form of death from anæsthetics. P.M. Lungs slightly congested. Mucous membrane of wind-pipe slightly reddened. Heart empty, left ventricle contracted. Right flaccid valves normal. Kidneys congested. More cerebro-spinal fluid than usual.	
242	48	M	Reduction of dislocated shoulder-joint.			Luxation reduced, but patient was dead. Usual efforts made for resuscitation.	? Syncope.	
243		M	Reduction of old-standing dislocation of shoulder-joint.			When bad symptoms came on, venous injection of ammonia used with no result.		Had been hard drinker.
244	30		Passing catheter for stricture of urethra.	Sponge tent. 2 dr.		Stage of excitement violent, arms and legs being moved violently. Held breath. Face became dusky. Sponge removed and no more chloroform given. Struggling continued and still held breath. Face became more livid. Slapped with wet towel which did not cause him to inspire. Face became darker and struggling ceased. Artificial R. caused some return of P. after $\frac{3}{4}$ hour, also galvanism, but no permanent good.	Over distension of right side of heart caused by violent movements of extremities and forcible holding of breath. P.M. Right side of heart gorged with fluid. Lungs deeply congested. Bladder thickened and dilated.	
245		M	For epithelial cancer of lip.					
246		F	Removal of cancer of breast.					
247	20	M	For aspiration of abscess in submental region.	3 dr.	P.	Struggled much during administration of anæsthetic but became quiet. Just as more CHCl_3 about to be given for operation patient became pale and P. stopped. Every means used to restore without avail.	Syncope. P.M. Left cavities of heart empty; right contained much dark brownish red fluid blood mixed with granular clot. Lungs emphysematous.	Patient a heavy drinker.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
248	50	F	For iridec- tomy for glau- coma in left eye.	Inhaler. 1 dr. 40 minims.	P. & R.	Became rigid, breathing stertorons, hurried and uneasy. R. watched and patient tried to eject saliva. Drew deep inspiration and ceased to breathe. P. stopped. Measures taken were: Wet towel, ammonia to nostrils, artificial R. (Silvester's method); only 1 or 2 efforts of breathing followed.	? Syncope. P.M. Anterior sur- face of heart loaded with fat, posterior wall of right ven- tricle very thin, muscle being appa- rently encroached on by fat, but no fatty degeneration. Aorta dilated and rigid with athero- matous deposit, right auricle disten- ded with fluid blood, valves healthy.	Patient had had same operation performed for right eye, and chloroform was given from same bottle on each occasion. The chloroform was sup- posed each time to be methylene bichlo- ride, but subsequent analysis showed that it was chloroform.
249							P.M. Right ventri- cle of heart dilated and fibres under- going fatty degene- ration.	
250	48	M	For fistula in ano.	Lint. 1 dr.	P.	P. ceased. Measures resorted to were: Drawing out tongue; artificial R.; slap- ping chest over heart with wet towel; ammonia to nostrils. Breathing feebly continued, after which two distinct gasps and patient died.	? Syncope.	Patient had taken CHCl ₃ before with- out difficulty.
251	23	M	Operation on finger.				P.M. "Inhalation of chloroform."	
252		M	Removal of adenoid growths at back of nares.	(1) Bag appa- ratus (Clover's); (2) blowing apparatus; (? Junker's) (3) bag appa- ratus; (4) blowing apparatus.	P.	Inhalation begun with bag apparatus and continued with blowing apparatus, but owing to vomiting former was substituted. When patient was under, an exploration of growth before operating caused delay, and he became half conscious. Blowing apparatus again used, patient drew in too much air through tube, so cambric hand- kerchief was placed over face. Then P. became weak and pupils dilated. Was laid on floor; artificial R. (Bain's and Silvester's methods) tried, to assist natural R. which still continued after P. ceased. Ammonia near mouth, cold affusions, hot cloths over chest also tried, and artificial R. continued for 1 hour. No return of P.	Syncope; when the handkerchief was laid over face CHCl ₃ vapour too strong for an enfeebled heart. No P.M., so the heart could not be examined, but the above reckoned the most probable cause of death.	
253		M	Removal of scrofulous tumour of jaw.		P. & R.	Suddenly P. and R. ceased. Artificial R. kept up nearly $\frac{3}{4}$ hour with no response to it at any time.	? Syncope.	
254	47	M	Reduction of dislocation of humerus.	Small quantity.	? P.	Patient soon began to struggle, and CHCl ₃ discontinued. Alarming symptoms came on, and artificial R., electricity, &c., em- ployed for nearly 1 hour with no avail.	? Syncope. P.M. appearances nil. Heart showed no disease.	Patient slightly under drink when about to be operated on. Ty- pansulation heart found to be weak and CHCl ₃ given very carefully.
255	48	M	Amputation of second finger.	Lint. 2 dr.	R.	Patient gave 2 or 3 snorts, became livid, R. stopped and P. very faint at wrists. Artificial R. (Silvester's method), with cold affusions, galvanism to heart and dia- phragm and ammonia to nostrils. Heart beat faintly at end of 20 minutes, but no R.	Failure of R.	Patient strong, healthy looking. A drukkard, and pas- sionate.
256		F	Extraction of pin from back of hand.			Fatal symptoms set in immediately after operation, and patient died.	? Syncope. Heart very flabby. Fatty degeneration.	
257		M	Dental.				Syncope.	
258	14	M	Examination of dislocated hip (2 minutes).	1 dr.	? P.	Patient seemed half sensible, then fainted, and state became dangerous. Artificial R. (Silvester's method) and galvanism tried without effect.		
259		F	Extraction of a tooth.					Sitting posture
260	19	M	Amputation of third toe.	On fold of lint, $3\frac{1}{2}$ dr.	P.	About end of operation P. failed and face became pale and livid. Window opened, water thrown on chest, pillows removed. R. became stertorous, then faint. Liquor ammonia to nostrils, friction and brandy to extremities. Artificial R. and inversion (Nelatou's method) and galvanism. No return of P. or R.	Syncope.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
261	56	M	Removal of tongue for epithelioma by galvanic cauterly (10 minutes).	Lint. 3 dr.	R.	R. became irregular and ceased. No stertor, failure of P. or pallor. Before R. ceased, artificial R. commenced, together with application of cold to chest, ammonia to nose, and galvanic current to diaphragm. These, with nutrient enemata, continued for $\frac{1}{2}$ hour. Pupils dilated. Heart beat some little time after R. failed.	Paralysis of nervous centres of R. P.M. Brain and heart healthy. Blood throughout body black and fluid. Lungs healthy; both pleurae adherent to thorax and diaphragm. Trachea and bronchi contained much grumous mucus.	Patient had suffered from epithelioma for $2\frac{1}{2}$ years, and for 3 weeks preceding the operation had only been able to take liquid food.
262	45	M	Amputation of little finger.	Folded towel.	? P.	Struggled violently, face became livid. All means of resuscitation without avail.	? Syncope.	Patient healthy man.
263			On canceroid of penis by galvanic cauterly.	Funnel compress with plug of lint. 12-15 grm.	P.	Became pale, P. stopped. R. was suspended and all efforts to restore animation useless.		
264	45	F	Removal of eye.	Flannel stretched on wire inhaler. Less than 3 dr.	P.	P. suddenly stopped, though breathing continued. Died while under influence of CHCl_3 . Every means used to restore patient, but of no avail. Means used were: Artificial R. (Nelatón's method), battery, and cold affusion.	? Syncope. P.M. All organs healthy except heart, in which was growth, about size of nut in anterior wall of right ventricle, and projecting into interior, of cancerous nature.	Heart had been examined but no evidence of disease found.
265	21	F	Puncturing abscess in abdomen.		?	When operation about to be begun, violent vomiting came on. CHCl_3 withdrawn, vomiting ceased and patient became partially conscious, then gave a gasp and died.	"Suffocation caused by impeded circulation of blood." P.M. Heart healthy, cavities empty, lungs diseased, cavity with pus in right lung, left lung consolidated and pleuritic adhesions. Liver softened and quantity of pus in peritoneum as result of peritonitis.	
266	11	M	Reduction of paraphimosis.			At close of operation patient ceased breathing; Nelatón's method resorted to produced a few gasping Rs. but all other efforts in vain. No assistance could be obtained till 30 minutes after patient's death.		
267		M	Removal of toe-nail.			"Got a whiff or two of CHCl_3 and was dead. He was sitting up."		
268	49	M	Reduction of dislocation of shoulder.	2 dr.		At moment of reduction of dislocation, slight shudder and tremor passed over patient. Inversion, pulling forward tongue with artery-forceps, and other means, tried without success.	Paralysis of heart. P.M. appearances nil.	
269	52	M	Canterisation of ulcer on left leg (5 to 6 minutes).	Linen, funnel shaped, with cotton wool at bottom. ? 25 grm.	P. & R.	Lividity, cessation of P. and R. Measures resorted to were: Opening windows, cold water affusions, friction over cardia; result, two sighing inspirations; next inversion, artificial R., application of hot iron over epigastrium and soles of feet.	Sudden paralysis of heart producing syncope. P.M. Lungs healthy, some pleural adhesions, easily separable, especially on left side, blood dark and fluid. Pericardium closely adherent to heart. Heart lax and collapsed.	Strongly built, thin, with well developed muscles. No appearance of cachexia. Had had ulcer for 20 years, much suffering for $\frac{3}{4}$ year before death.
270	56	M	Removal of superficial sequestrum from surface of left thigh bone.	Long cone. 1 dr.	P. & R.	Lividity. R. irregular and noisy. Patient turned over to left and tongue pulled out. Breathing and P. became good. Operation then commenced, patient again became livid, breathing noisy and irregular. P. and R. then ceased. For 20 minutes attempts at restoration were made by artificial R. (Silvester's method), galvanism, ammonia injection (intravenous), friction, cold applied to chest walls—all with no avail.	? Syncope. P.M. Lungs healthy. Heart: deposit of fat on surface, but healthy, aorta atheromatous. Liver: surface with one small nodule (syphiloma). Kidneys granulated and contracted.	Stout and muscular, no external signs of organic disease. Slight areus senilis. Anxious, timid and sensitive to pain.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
271	42	M	Removal of right eyeball.	1½ dr. (about).	P.	After a second dose P. failed. Patient seized by fect and head lowered. Artificial R. practised, and piece of wood from fire applied to breast, but death in ½ hour.	? Syncope.	No disease of heart and free from excitement prior to operation.
272	48	F	Surgical.				"From a surgical operation during the inhalation of chloroform."	
273	14	M	Extraction of tooth.		R.	Tooth extracted, when patient suddenly ceased to breathe. Was sitting upright in chair when CHCl ₃ given immediately after eating heavy meal. Fifteen minutes elapsed before any efforts made at resuscitation.		Sitting posture.
274	22	M	Circumcision for venereal warts and chronic phimosis.		? P.	Face became livid and circulation stopped. Galvanism, cold affusions, and ammonia tried with no success.	Syncope.	Patient had lately suffered from typhoid fever which would account, perhaps, for weakness of heart.
275		M	Amputation of elbow-joint.	3 dr.	P.	P. ceased; died instantly. Usual restorative measures adopted with no success.	Paralysis of heart. P.M. showed heart larger than usual and other traces of disease.	Examined previously with stethoscope and no evidence of heart disease obtained.
276		F	Removal of stumps of teeth.			Change suddenly came over patient. Cold affusion in face. Breathing became slower. Was thrown on floor; she then ceased breathing. Artificial R., Hall's method not answering, Silvester's tried, she then breathed 2 minutes and then ceased. Galvanism tried with no effect.	Arrest of heart's action, heart being weakened from certain forms of disease as seen by P.M.	
277	45	F					P.M. "Administration of chloroform."	Was suffering from dysentery.
278	53	M	Removal of finger.	Less than 1½ dr.		Livid though R. regular, stertor. Measures resorted to were: Drawing out tongue; artificial R. (Nelson's and Silvester's method) for ½ hour with no avail.	? Syncope.	Patient thoroughly examined before operation as to state of heart.
279	21	F	To pass aspirating needle into tumour.	About ½ oz.		A good deal of struggling at commencement of inhalation, and just as needle was to be plunged into abscess vomiting came on. When the vomiting had ceased partial consciousness had returned, and more chloroform was about to be given when a gurgling noise was heard, then patient became ghastly pale and died. Artificial R. was resorted to with no avail.	? Syncope. P.M. Pleuritic adhesions over the sides and bases of both lungs, and over the middle lobe of the right lung there was a small abscess containing 2 oz. of pus. Partial consolidation of each base. Heart healthy and empty. Large abscess in left iliac fossa of abdomen nearly up to umbilicus. Source of abscess not traced. No inflammatory lymph over intestines which appeared healthy. Brain normal, said to be anæmic.	Patient had pleuro-pneumonia about May 26. From that time till July 7 the worst symptoms improved. About June 5 tenderness over left ovary was noticed and this increased till July 7 when the operation took place.
280	25	F	Obstetric for version.		P. & R.	As patient did not wake after inhalation, house surgeon (not hitherto called) sent for. P. thready, face blue, breathing very imperfect. Restorative measures unsuccessful; died 10 minutes after house surgeon's visit.	? Syncope.	
281	27	M					P.M. "Death from chloroform. General emphysema of lungs."	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
282	45	M	Removal of tumour involving hard and soft palate.	Clover's apparatus; flannel cone.	R.	Struggled violently, rose to his feet (seated in chair) and pulled gag from mouth. Was laid on table <i>before</i> CHCl_3 recommenced, and CHCl_3 given by flannel cone. Breathing ceased, face turned dusky, tongue protruded between teeth. Tongue at once drawn forwards; head and shoulders pulled below level of table, body turned upwards, and artificial R. (Silvester's method) tried for $\frac{1}{2}$ hour. A few gasps. Slapping with wet towels and faradism to phrenic nerve, and epigastrium also tried.	?	Patient advised not to have an anæsthetic.
283		F	Extraction of teeth.			2 or 3 stumps extracted, when face became deadly pale. Measures to restore animation adopted and medical assistance sent for. Death took place immediately.	P.M. Heart flabby and light coloured. Lungs and brain moderately congested, but no other appearances.	Sitting posture. Dentist (qualified surgeon) absolved from blame. Healthy subject, "No one's fault."
284			Small operation.					
285	60	M	Reduction of subglenoid dislocation of humerus.	$\frac{1}{2}$ dr.	P.	Pupils began to dilate and heart's action to fail. Restorative measures of every kind of no effect, and patient died in a few minutes. Among measures used were drawing forward tongue, artificial R. and galvanism.	From fatty degeneration due to drinking habits. Syncope. P.M. Heart fatty and degenerated, and kidneys granular.	Patient had been hard drinker, but for a few months "temperate." Nothing in previous examination to contra-indicate use of CHCl_3 .
286	45	M	For exploration of sinuses in right femur (13 minutes).		P.	Violent struggling, stoppage of P. Usual methods of resuscitation with no effect.	Syncope. P.M. Fatty degeneration.	Healthy looking man.
287	8	M	On left knee bent almost at right angle.	On lint. $1\frac{1}{2}$ to 2 dr. in 2 doses.	P.	Towards end of operation, which was rather prolonged, P. stopped. Measures resorted to were: Holding up by legs, artificial R., slapping with wet towel, application of hot sponges to heart, enema of brandy and ammonia, and of ammonia and nitrite of amyl to nostrils. Artificial R. continued for $1\frac{1}{2}$ hour.	? Syncope.	
288	33	M	Reduction of recent inguinal hernia.	Folded lint. 2 dr. (about).	P.	P. became feeble and R. stertorous, face livid. Measures resorted to were: Putting pillow under shoulders so that head fell backwards, tongue drawn forward by forceps, artificial R. (Silvester's method), injection of brandy 2 oz. with warm water per rectum, flapping chest with wet towels, rubbing and warming extremities. Patient ceased breathing 3 or 4 minutes from beginning of seizure. Faradism to phrenic nerve tried later on and artificial R. kept up $\frac{1}{2}$ hour.	P.M. Lungs and brain congested. Heart large, cavities full of dark blood. Right ventricle thinner than normal, and overlaid with fat. No naked eye evidence of fatty degeneration.	Patient not strong. Hernia not strangulated; attempts to reduce it after bath unsuccessful.
289	30	F	Extraction of tooth.					Sitting posture.
290		M	Extraction of thorn from foot.					
291		F	For labour.					
292		F	For labour.		P.	CHCl_3 given for slight convulsions; pains returning, more given; tremor occurred, P. ceased, and patient was dead.	? Syncope.	
293	37	M	Removal of carious bone from stump of arm.	Lint. 2 dr.	P. & R.	Breathed equally for a few moments, but when bone was grasped, breathing stopped and P. ceased, about same time. Artificial R. performed (Silvester's method) for $\frac{1}{2}$ hour. Brandy not given.	Syncope. P.M. Marked fatty degeneration of heart. See <i>Boston M. & S. J.</i> , 22 Feb. 1877, p. 234, where the administration of CHCl_3 in this case is severely criticised. See also <i>M. P. & C.</i> , 11 April, 1877, p. 289, where report of this case is quoted from <i>Student's J.</i> in which the heart is stated on P.M. examination to have been found <i>fairly healthy</i> .	

SERIES B.
DEATHS UNDER CHLOROFORM.
CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
294		F	Removal of tumour in throat.			Died before operation could be completed. All efforts to restore consciousness futile.	"Spasm of larynx."	
295	43	M	Amputation of finger.	Lint. Over 1 dr.	R.	R. ceased and then P. in temporal arteries could not be felt. Artificial R. started and kept up $\frac{3}{4}$ hour; left external jugular vein opened; battery and every other means used to restore animation.	? Asphyxia from pressure of bronchocele. P.M. Heart contracted and empty, fatty degeneration. Bronchocele involving left lobe of thyroid gland.	Had taken meal shortly before coming to hospital. In habit of drinking three gallons of beer daily.
296	52	M	Reduction of strangulated hernia.	On thin handkerchief. 2 dr.	P. & R.	After small 2nd dose had been given on account of returning consciousness, breathing became suddenly shallow and irregular and radial P. could not be felt. Usual means of resuscitation resorted to but patient never rallied.	? Syncope. No P.M. allowed.	History of rheumatic gout.
297	43	F	For aneurysm of aorta pressing on trachea (2 minutes).	Small quantity.	R.	Exhibited signs of obstruction, superincumbent position increasing pressure on windpipe. Artificial R. of no use so laryngotomy performed, but left innominate vein being occluded some veins crossing, larynx dilated and wounded in operation. Quantity of blood entered air passages; though sucked out, delay fatal.	Asphyxia from pressure. "Patient had declared she could not lie down without choking. Two pillows were, however, placed under her head and she was persuaded to recline." <i>Students' J.</i>	
298	56	M	For fistula.	3 dr.	R.	Violent muscular spasm, R. became embarrassed, and death took place in spite of every effort at resuscitation.	Failure of R. owing to muscular spasm, as the respiratory muscles as well as other muscles of the body were in state of rigid contraction.	"At these times the administration of CHCl_3 should be entirely suspended till spasm ceases."
299		M	For perineal fistula.			Death ensued quickly on stage of struggling.	Asphyxia, according to P.M. appearances. Anaesthetic given while tonic muscular contraction going on.	
300	27	M	For disease of knee (chronic synovitis).	Skinner's inhaler.	P.	Alarming symptoms appeared, and death took place in a few minutes. Tongue drawn forward, face and chest slapped with wet towel, enema, nitrite of amyl, artificial R. (Silvester's method).	? Syncope. P.M. Fatty degeneration of heart.	Intemperate.
301	23	F	Operation on eye.	4 dr.		Operation performed but patient died a few hours later.	Effusion of blood on brain, death accelerated by vomiting caused by administration of CHCl_3 . P.M. Brain softer than natural, coagulated blood in several places.	Examined previously to operation and found to be fit subject for CHCl_3 .
302	38	M	Reduction of paraphimosis of three days' standing.	Lint.	P. & R.	R. suddenly stopped, face livid, lips blue, P. failed. Artificial R. resorted to, and chest flicked with wet towel. After 5 minutes R. restored, but no return of P., hypodermic of brandy ($\frac{1}{2}$ dr.), and faradisation employed, artificial R. kept up $\frac{3}{4}$ hour.	Syncope. P.M. Heart dilated and fatty, walls flaccid, no valvular disease, lungs and all internal organs congested.	Nothing seemed to contra-indicate use of CHCl_3 .
303		F	Slight operation.	2 dr. (given drop by drop).			P.M. Fatty degeneration of heart.	
304	48	M					P.M. "Death under chloroform."	"Aneurysms of abdominal aorta, popliteal arteries," &c.
305	29	M	For fistula in ano.		? P.	Patient became suddenly blanched in face and breathed feebly. Artificial R. for 1 hour, but patient died.	P.M. Heart hypertrophied.	Patient in fairly good health.
306	23	F					"Chloroform inhalation." P.M. refused.	"Old disease of kidney, perinephritic abscess, psoas abscess."
307	18	M	Removal of elongated and indurated prepuce (2 or 3 minutes).	1 dr.	? P.	Spasmodic change, sudden lividity of countenance, and sudden dilatation of pupils. Measures resorted to were: Dashing cold water on face and chest, admitting air into room and artificial R. for long time.	No P.M. allowed.	Heart previously examined; nothing found to forbid use of CHCl_3 .

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or P.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
308		F	Removal of tumour in axilla.	Small quantity.		CHCl ₃ had been given and patient died suddenly.	? Syncope. P.M. Fatty degeneration of heart.	
309	41	M	Extirpation of right eye-ball (8 to 10 minutes).	Skinner's Inhaler. 3 dr.	R.	After 3 or 4 minutes, stage of excitement entered which lasted 2 or 3 minutes. Again became quiet, conjunctivæ became insensible to touch, pupils contracted, muscular relaxation not complete, jaws firmly clenched, P. and breathing good. Operation commenced, breathing ceased, P. still going. Chest at once was compressed, but in 1 or 2 seconds P. had stopped. Artificial R. (Silvester's and Sayre's methods) $\frac{1}{2}$ hour, galvanism, inversion, dashing of iced water on face and chest, and ice in rectum. Patient breathed a few times, but no P. or heart beat. R. and action of heart seemed to cease almost simultaneously.	Syncope. P.M. Heart 12 oz. Left ventricle 2 dr. fluid blood, right ventricle the same, muscular substance flaccid with commencing fatty change. Lungs emphysematous, no marked congestion, frothy serum on section. Kidneys very congested, slight granular change. Liver congested, healthy. Brain: congestion of cerebral veins on section.	Apparently healthy before administration, heart acting powerfully and sounds clear.
310		F						
311	34	F	For fistula in ano.	Foie's of lin ^g . 3 dr.	P.	Just as division of fistula was being performed, 2 minutes after withdrawal of CHCl ₃ patient gave sharp scream, pupils dilated, urine passed involuntarily, face became pale, heart's action and P. suddenly ceased, and shortly breathing ceased too. Measures resorted to were: Artificial R., admitting fresh air to room, interrupted shocks to heart from coil, brandy injection per rectum, opening of right median basilic vein. A few feeble R's. resulted, but in an hour attempts abandoned as hopeless.	"Death from action of chloroform on diseased heart." P.M. Heart collapsed, pale, covered with layer of fat, weighed $9\frac{3}{4}$ oz., cavities empty, walls very thin and pallid, well marked fatty degeneration. Apparently atheromatous patch on mitral valve, base and transverse part of aorta atheromatous.	
312	41	M	For perineal metrotomy ($\frac{1}{4}$ hour).	1 oz.	R.	Operation had been performed and anæsthetic removed for a few seconds, when patient ceased to breathe. Efforts made to restore life—but without avail—were artificial R., amyl nitrite, inversion, &c.	? Syncope.	
313			Amputation of leg.			Died before amputation could be begun.		
314								
315		M	For iridec-tomy.	3 dr.		Was not unconscious of pain at beginning of operation, which lasted about 5 minutes. Heart stopped suddenly; 2 or 3 gasping inhalations. Efforts at resuscitation unavailing.		Had inhaled 2 dr. CHCl ₃ the preceding day without injury.
316	38	F	Reduction of dislocation of elbow.	Inhalation by Simpson's method. Small quantity (40 drops).		Alarming symptoms; artificial R., ammonia, vapour, and Hoffman's ether used with no avail.	"Inability of a weak heart to carry on circulation through the lungs." P.M. Fatty heart.	
317	34	M	For fistula in ano.	On lint. 2 dr.	P.	Struggled violently, pupils became largely dilated, and P. stopped. Galvanic battery to cardiac region, chest struck with cold wet towel, and brandy injection per rectum. Breathed spasmodically. Lifted up by feet for few seconds and breathed more regularly. Lifted up again, no improvement, but causing congestion of head. Five minutes from the time struggling began he ceased to breathe altogether. Artificial R. and galvanic battery tried for 20 minutes.	Syncope. P.M. Pleural cavities and pericardium empty and with no adhesions. Lungs congested. Heart covered with fat, flabby, pale, dilated, valves healthy, cavities empty, wall thin. Microscopically heart showed fatty degeneration.	Besides the fistula in ano, patient had ulcer of right leg which healed under treatment. Health otherwise robust. Auscultation showed nothing wrong about heart. Very excited before operation.
318	15	M	On stump of arm.	On lint. $2\frac{1}{2}$ dr. used, of which much supposed to have evaporated from lint.	P.	After completion of operation breathing stopped. Tongue drawn forward and breathing began again. Showed signs of feeling in stump of arm. Breathing loud and peculiar. No radial P. felt and no bleeding from wound, heart's action having ceased. Means for resuscitation	Syncope. P.M. Right apex of lung slightly adherent. Pericardium contained 2 dr. of clear serum. Heart: valves healthy, right	Of florid complexion and apparently in good health. Arm had been amputated seven years previously. Stump had become conical and

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
319	3	M	For unal-formation.	20 minims.	P.	were: Galvanism, artificial R., friction, brandy and ammonia enemata, champagne passed into stomach by means of tube; restorative measures used for $\frac{1}{2}$ hour. P. suddenly stopped and apparatus removed. Patient recovering. CHCl_3 again given, P. again stopped and R. ceased. Artificial R. used with no avail.	side distended with fluid blood, left, contracted, muscular tissues healthy. ? Syncope. P.M. Showed patient to be weakly and that "lungs had never been properly inflated."	skin had ulcerated over end of boue.
320	22	F	Labour.		P.	Tremor occurred. P. ceased.	No cause of death found beyond giving CHCl_3 .	"Patients in labour do not enjoy any absolute immunity from the pernicious effects of chloroform. Both patients free from cardiac or pulmonary complications."
321	25	F	Labour.			"As patient did not rouse after inhalation, surgeon called in, who found a thready pulse, face blue and R. imperfect. In 10 minutes woman died."		
322		M	For hydrocele.	15-20 grm.		"Every means of recovery including tracheotomy tried in vain."	P.M. Nothing remarkable with respect to organs of R. and circulation was found. "Chloroform administration." P.M. Syncope.	
323	25	M	Circumcision.					
324	8	M	On knee.	4 dr.		Operation concluded, when lividity of countenance noted. Measures employed were: Artificial R. and battery for $\frac{3}{4}$ hour with no result.		
325			To procure sleep when under delirium tremens.					Patient was suffering from injury to foot.
326		F	For tumour on right breast.		P.	P. began to fail, and in spite of restorative efforts, patient died.		
327		M	For contractions of legs and arms.		R.	As patient was not sufficiently under influence of CHCl_3 , more was given, when it was found R. had ceased. Artificial R. with no effect.		Had been operated on under "Bichl. Methyle" the day previous.
328	38	M	Perineal fistula.				P.M. "Pyelitis, ascending nephritis, chloroform."	
329	33	M	For fistula.		P.	Very superficial R. continued "long after" heart's action had ceased.	Syncope.	A powerfully built man; had formerly suffered from delirium tremens and typhus.
330					P.	Very superficial R. continued "long after" heart's action had stopped.	Syncope. P.M. before putrefaction had set in showed air bubbles in the blood of the sinuses in the vessels of the pia mater, in that of both sides of the heart and in the pulmonary vessels. Heart flaccid, not diseased.	A broken-down person. For last year had been inmate of lunatic asylum.
331		M	For enucleation of eye ball.		P. & R.	Suddenly ceased breathing and face became livid, operation being completed. Measures resorted to were: Pulling forward tongue and artificial R., galvanism and uirrite of amyl.	Syncope. P.M. appearances <i>nil</i> , except intense congestion of kidneys.	
332			Removal of orbital tumour.					
333		M	Removal of small piece of bone.					Had taken CHCl_3 well before. Previous to that was given ether, but bearing it so badly preference was given to CHCl_3 .
334	14	F	On abscesses in elbow-joint.		? P.	Breathing soon became noisy and embarrassed; lips and face turned livid. Usual restoratives, with no avail.		

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
335 336	11	M	Removal of bone from leg.				Syncope. P.M. showed extensive adhesion of the pericardium.	Given at patient's desire, who had taken it on 3 previous occasions.
337	17	M	On left foot.	3 dr.	R.		Asphyxia hastened by action of CHCl_3 on congested lung. P.M. Heart: normal, left side empty and contracted, right filled with black fluid blood, 3 dr. of blood in pericardium. Lungs: right congested, left hepatised, with adhesions.	
338			Removal of projecting phalanx from injured finger.			Death occurred before operation. Usual restorative means attempted.	? Syncope.	
339	20	M	Extraction of teeth.	Napkin with paper funnel. 3 oz.		Patient soon under influence of vapour; tooth extracted became partially sensible; more CHCl_3 given, 2 teeth extracted, again partially sensible; another tooth extracted <i>without</i> more CHCl_3 . Patient then began to struggle and show signs of pain. Head brought forward, mouth well cleared. Then put in former position, when suddenly threw up arms, rolled eyes, and ceased to breathe. Measures used were: Inversion, drawing forward tongue, artificial R. Heart still beating, no pulsation at wrist, face very livid, no natural R. Electricity and iced water employed also. Efforts continued for 1 hour.	P.M. Fatty liver, the only pathological state found.	Sitting posture.
340	50	M	Reduction of dislocated hip (5 minutes).	2 dr.	P.	Before operation had been begun, countenance changed and P. ceased. Electricity applied, lower limbs elevated, artificial R. for 1 hour, and other means with no success.	Syncope. No P.M.	Heart and P. had been carefully examined before administration.
341		M	For necrosis of tibia.	Small quantity.	R.	Before fully under anæsthetic R. stopped and could not be restored.	P.M. Brain softer than natural.	
342	36	M	Extraction of teeth.			Two teeth had been extracted when it was found that he had ceased to breathe. Artificial means to restore R. proved fruitless.		Sitting posture.
343	48	M	Reduction of dislocation of shoulder.		P.	Action of heart suddenly failed. P. stopped before breath ceased. Usual restoratives applied.	Paralysis of heart. P.M. Heart large, with much fat in its substance. Lungs emphysematous. Liver fatty. Large ecchymosis in axilla and pectoral region.	
344	50	M	Removal of enchondroma of upper lip (7 minutes).		P. & R.	Seven minutes after CHCl_3 given P. and R. ceased. Means resorted to were: Artificial R., tongue drawn forward, faradism, and tracheotomy.	? Syncope. P.M. Extreme emphysema of lungs, hypertrophy of right ventricle, congestion of liver and kidneys, and arterial atheroma.	Patient was subject to pulmonary emphysema, but no obvious cardiac disease.
345		M	For hernia.				Syncope.	Had been without proper food for 9 days. Was complaining of severe pain in lower part of body, and was sent to the infirmary.
346		F	For abscess of the breast.			After a few inspirations of the anæsthetic she became insensible and all efforts to restore life were in vain.		
347	40	M	For stone in bladder.	Folded napkin.	? R.	Before becoming totally unconscious, patient sprang from table and struggled with those holding him; strength gave way, he sank on floor and ceased to breathe. Artificial R. for $\frac{1}{2}$ hour without avail.	Syncope. P.M. Fatty degeneration of heart.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
348	40	M	Reduction of subglenoid dislocation of the shoulder.		P.	After 6 or 8 inhalations of the chloroform his P. ceased and all efforts to revive him failed. Artificial R., electricity and digitalis.	P.M. revealed no heart disease.	Had twice before had dislocation reduced at hospital under chloroform, and "This man was known to have had CHCl_3 as many as 8 times on former occasions".
349	35	F	Extraction of teeth.	Skinner's inhaler. 2 dr. (little over.)	? P.	When stumps were being removed patient jumped up and began to struggle with operator and administrator as if hysterical. This lasted 2 minutes. Then swooned back and was dead in 5 minutes.	? Syncope, &c.	Patient had taken CHCl_3 twice before. Examination of heart showed no indication of disease.
350	50	M	Amputation of leg.	Skinner's inhaler. ? 2 dr.	P & R.	At commencement of operation patient seemed as if wanting to vomit, but only spat out a little mucus. In $\frac{1}{2}$ minute jaw dropped and faced turned blue. Tongue drawn out and artificial R. begun. R. had ceased, no P. at wrist. In 5 minutes both returned, when suddenly P. flattered, became intermittent and stopped altogether, R. failing at same time. Artificial R. carried on some time longer.	Syncope. P.M. "Fatty heart, cedematous lungs; granular kidneys."	Had taken CHCl_3 twice before
351	49	F	Amputation of breast.	2 dr.	P.	Took several long inspirations and passed into the excited stage. Directly this was over the P. ceased to beat, but 2 slight inspirations were made.	P.M. No disease of lungs or heart. Arachnoid very opaque, and large effusion of blood. Syncope.	Patient stout and full-blooded; nervous at taking CHCl_3 . Intemperate.
352	42	M	For epulis of upper jaw.		P.	Patient had just come under influence of anæsthetic when heart's action was arrested. Measures taken were: Drawing forward tongue, artificial R., galvanism to carotid region and hypodermic of atropine.		Anæsthetic carefully administered.
353	59	M	For lithotomy.	2 $\frac{1}{2}$ dr.		As operation was going on patient seemed to have fainted. Artificial R. for $\frac{1}{2}$ hour without effect.	Syncope. P.M. Heart weak and flabby, especially right ventricle.	Had undergone a first operation for lithotomy successfully under CHCl_3 , this having taken place recently.
354	15	F	For strabismus.	2 doses. (1) 2 dr. (2) less quantity	P. & R.	After left eye had been operated on successfully and dose for operation on right had been given and operation commenced, breathing and P. both failed. Every effort to restore animation unavailing.	Syncope.	Patient a fit subject for CHCl_3 .
355	18	F				"Effect of drug too powerful; galvanic battery applied, consciousness could not be restored and patient died."	? Syncope.	
356		F				Died under the influence of chloroform prior to an operation.	? Syncope. P.M. Heart of deceased was very small, but the organs were perfectly healthy.	
357	43	M	For incisions into subcutaneous structures (crisipelas).	Inhaler, flannel over wire frame.	P. & R.	Immediately patient came under influence of CHCl_3 he ceased to breathe and P. stopped. He drew a few breaths after this. Tracheotomy, galvanism and artificial R. for 1 hour were tried, but all unavailing.	Syncope. No P.M.	Patient had taken CHCl_3 well a month before.
358	35	M	Removal of wen from neck.				? Syncope.	Patient 6 ft. 7 in. in height.
359	31	M	Removal of tumour.	On towel. 3 dr.	? P.	Face became livid, breathing slow and laboured, gasped and colour became purple. Battery and artificial R. (the latter for 1 hour) were tried with no success.	P.M. Heart diseased. Syncope. P.M. Heart flabby.	
360	41	M	Reduction of dislocation of left shoulder ($3\frac{1}{2}$ or 4 minutes).	On cone of lint. 2 dr.	P.	Immediately after operation breathing became stertorous, face congested, P. suddenly stopped. Measures for resuscitation were: Artificial R. for $\frac{1}{2}$ hour, enema of brandy, galvanism.	Syncope. P.M. Fatty change in heart with fibroid thickening of valves which were however healthy.	
361	55	M	For uterine tumour ($1\frac{3}{4}$ hour).		P.			

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
362	60	M	For cataract (about 5½ minutes).	On funnel-folded towel. In 2 doses, less than 2 dr.	P.	Face became livid and P. suddenly ceased. All restorative efforts useless.	From "heart disease" according to verdict at inquest, but this not borne out by P.M.	Patient had been run over and slightly injured a fortnight before operation. This was not known to surgeon till after his death.
363	27	M	Rectifying defective position which leg had taken after compound fracture.		P.	When operation completed patient became suddenly livid and heart ceased to beat but R. continued considerable time. Measures employed were: Artificial R., galvanism, brandy injections.	Syncope. P.M. Liver fatty. Heart in most advanced state of fatty degeneration.	
364	9	M	For abscess in thigh and spinal disease (a few minutes).			Operation successfully performed but patient never recovered consciousness.		
365	45		Dental.		R.	Breathing suddenly ceased and death almost immediate.	Syncope.	Patient apparently healthy. Was sitting up in chair when CHCl ₃ was given.
366		F	Dental.					
367		M	For sympathetic ophthalmia.			Anæsthetic not given many minutes before patient died.		
368		M	Reduction of dislocation of shoulder.		P. & R.	At convulsive stage, breathing suddenly ceased and it was found that heart had stopped.	Syncope.	Vigorous man.
369	50	M	Reduction of subcoracoid dislocation of shoulder-joint.	Handkerchief, 2 dr.	P.	Before operation patient raised his body, got black in face and died. Artificial R. for ½ hour of no effect.	Syncope. P.M. Heart in state of fatty degeneration, and other organs extensively diseased.	
370							? Syncope.	
371	21	M	Adenoma of neck.			Operation almost performed when P. was found to have become thready. Battery sent for but in ½ minute patient was dead, though battery arrived and was applied. No means were successful in bringing patient back to life.		This death occurred on the very day that M. Gosselin formulated the proposition at the Académie de Médecine, "that chloroform was never the cause of death when it was well administered."
372	23	M	Excision of eye-ball (8 minutes).	"Towel over face, Edinburgh method."	P.	After operation had begun, patient began struggling, towel was replaced, and at once P. failed. Remedial efforts unavailing.	? Syncope. No P.M. appearances, except some copper-coloured spots on legs.	
373	9	M	On bronchocele.		R.	When nearly under influence of anæsthetic breathing became worse. Incision in tumour having been made patient became quickly livid, was making respiratory efforts, but no air entered chest. Tongue drawn forward and position of head and neck changed with no advantage. Tracheotomy could not be performed. Artificial R. commenced, flexible catheter being passed through glottis, and was kept up ½ hour. The P. kept good.	Asphyxia. P.M. Tumour an enlargement of thyroid. Passage of trachea where pressed on by tumour very much contracted. Mucous membrane slightly swollen. Lungs congested. Numerous bullæ under visceral pleurae.	Patient's R. very defective from the tumour pressing on trachea.
374	29	M	Opening abscess in sac caused by strangulation of large right inguinal hernia.	Lint in cone-shaped compress. 4-6 grm.	P.	Operation commenced. R. strong, a little stertorous, P. good. P. grew weaker little by little and R. also grew weak and finally stopped, although the compress had been removed some minutes. Mouth to mouth insufflation, artificial R. (Chaussier's tube) did not succeed in restoring animation. At 3 intervals there was a deep inspiration but death took place.	Syncope. P.M. Heart: mahogany-coloured. Lungs: pseudomembranous pleurisy somewhat advanced, not having given place to appreciable reactionary phenomena.	Patient was small, wretched-looking, of alcoholic habits, and was attacked with "guêde deloup." On account of deformity of throat more than usual precautions taken with chloroform. The chloroform was not absolutely pure; it contained a little alcohol, but this fact counted for nothing in the causation of death.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
375			Reduction of dislocated shoulder.				Asphyxia caused by pulmonary congestion.	
376	31	M	Forceful stretching of sciatic nerve.	Intermittingly on a compress. Had not in spired 10 grm.	R.	After complete anæsthesia was obtained, operator bent leg and thigh upon trunk in such a way that the foot was carried to the neighbourhood of the head. Patient became livid, stopped breathing, and died. Lowering head, artificial R., electricity and tracheotomy were tried in vain.	P.M. Lungs congested on side of fracture of ribs. Respiratory failure and syncope.	Was suffering from sciatic neuralgia that defied treatment, but was otherwise vigorous and in perfect health.
377	38	F	Reduction of fracture of leg.		P.	For 2 minutes all well, but collapse followed. Artificial R. and other methods useless.	Syncope. P.M. Fatty degeneration of heart—"heart which could not resist the shock of pain first and of chloroform upon pain."	
378	34	F	For ovariectomy.				"Collapse," verdict at inquest.	
379		M	Removal of tumour from nape of neck.	Scotch method.		Died suddenly before commencement of operation.	? Syncope.	Healthy man.
380	35	F	For fistula in ano.	On folded lint.		At stage of muscular rigidity P. stopped. Measures to restore adopted were: Cold affusion, artificial R., application of faradic current.	P.M. Heart exceedingly fatty.	
381	49	M	Removal of diseased bone of right foot (10 minutes).	3 dr. (less than).	P.	Piece of diseased bone having been removed patient struggled, sat up in bed. P. at wrist became weak, flickered and stopped, face became livid, but temporal artery still beating. Pupils fixed, not dilating. Artificial R. and faradic current to phrenic nerve were tried but patient only gave 2 or 3 gasps.	? Syncope. No P.M.	Patient looked older than he really was. P. strong and regular, and a little hard. No signs of cardiac mischief.
382	52	M	On cancerous growth on lip.	On lint. 1 dr.		Patient became very violent, P. became imperceptible, and breathing after 4 or 5 Rs. seemed about to stop. Artificial R. and other means used without avail.	Syncope. P.M. Heart large and flabby; extensive atheroma of coronary arteries; no fatty degeneration; no valvular disease.	No examination of heart was made prior to administration, but it is doubtful whether any examination could have revealed a dangerous state of the organ.
383	14	M	On dislocation and fracture of bones at elbow.	Inhaler. 1½ dr. given at a time.	P.	After operation, when patient was beginning to recover, he raised himself. In 10 minutes more, breathing prolonged and slow, pallor and cessation of P. Jaw drawn forward; took inspiration. Tongue drawn forward with artery forceps, cold water on face and chest, head lowered further. Silvester's artificial R. used, battery applied and ammonia to nostrils. Died in 2 minutes from first symptoms being noticed. Artificial R. kept up some time.	Syncope. No P.M.	Heart examined before operation. Found normal, though slightly weak.
384		M	For stricture of urethra.	2 dr.		Patient suddenly ceased to breathe and died in two minutes. Usual restorative means without success.	? Syncope. P.M. Heart undergoing fatty degeneration.	Patient had not led very regular life, and was somewhat intemperate.
385	40	F	For lateral fissure of the cervix uteri.	Towel folded in funnel shape. 3 dr. (less than).	P. & R.	Became cyanosed, eyes staring and fixed. R. embarrassed, gurgling noise in bronchi. Measures adopted were: Raising head and turning body into supine position, opening windows, cold affusions, slapping, depressing head and raising body and lower extremities; brandy injection and hypodermic of liquor ammoniac and brandy; applying hot towels over cardiac region, vein in arm, and then right jugular, opened—all with no avail.	Paralysis of heart. [Fright and terrible anxiety may have had much to do with fatal ending of case.]	Was of peculiar nervous organisation, thin, and anemic.
386	36	M	Amputation of left thumb.	Inhaler. 90 drops, 1½ dr.	P.	Showed symptoms which necessitated restorative measures being used. On his coming to and operation being hastened, P. failed, heart ceased beating, and patient was dead.	Syncope. P.M. Fatty degeneration of heart.	Fatty degeneration could not be detected by the stethoscope.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
387	33	M	For cancer of tongue.		P.	In 3 or 4 minutes turned blue; pulsation ceased. Restoratives administered without effect.	? Syncope. P.M. Kidneys and liver much diseased; heart so slightly that nothing could be detected during life.	Patient was examined thoroughly before-hand.
388	58	M	For cancer of tongue.		P.	P. stopped, patient became livid and commenced gasping. Restoration tried without effect; operation not begun.	Syncope.	
389		M	For double fracture of jaw.		P.	Death occurred during administration of CHCl_3 . When the struggling (which was excessive) ceased, the P. was imperceptible and after about 6 respirations, breathing stopped.	Asphyxia. P.M. Larynx injured, extravasation base of tongue, and accumulation of blood in trachea.	
390		F	Extraction of teeth.					Sitting posture.
391-392								
393		M	Amputation of finger.			Before operation began, patient ceased breathing.	? Syncope. P.M. Cardiac disease, result of old attack of pleurisy.	Patient apparently healthy.
394	35	F	Extraction of teeth.	2 dr.			? Syncope. Had diseased heart and kidneys.	Had taken CHCl_3 well 3 weeks before; administered by same dentist. Sitting posture. Sitting posture.
395		M	Extraction of tooth.	Folded towel. 2 teaspoonfuls.		Alarming symptoms supervened. Measures adopted were: Artificial R., nitrite of amyl, suspension with head downwards, all unavailing.		
396	5	F	On diseased knee joint.	Small quantity.	P.	Operation having been performed, which occupied but a second or two, child's heart suddenly ceased to beat. Every means used in vain to restore R.	Syncope as shown by P.M.; also from debility following diseased knee joint.	Had taken CHCl_3 twice before.
397	50	F	Opening abscess in thigh.		P.	Operation about to be commenced when P. failed.	? Syncope.	Bronchitic and asthmatic, with very feeble circulation.
398		F		On a towel About 1 dr.	P.	While the inhalation was proceeding, the pupils of both eyes slowly dilated to 2 or 3 times their natural size. On being spoken to the patient answered intelligibly but as she spoke her P. abruptly ceased beating. R. continued for some seconds afterwards.	? Syncope.	Prior examination had detected no disease of heart or lungs.
399	10	M	Extraction of tooth.			On first indication of alarming symptoms, artificial R. tried which kept up life for 2 hours and then patient died.	"Death from gradual paralysis of nerves of heart and respiration."	Sitting posture.
400-406								No comment.
407	7	M	Opening abscess in knee-joint.			Died before operation was performed.	Syncope.	
408	50	M	For stricture in membranous portion of urethra (external urethrotomy).			While the anæsthetic was being given, during stage of excitement, patient raised himself suddenly and fell down dead.	? Syncope.	An ounce of whiskey had been given $\frac{1}{2}$ hour before, and another ounce just before using the CHCl_3 .
409		F	Removing tooth.			When the tooth had been drawn, patient found to be dead.		Was in good health, suffered from occasional neuralgia ascribed to ulcerated gum. Sitting posture.
410		F	Extraction of teeth.		? P.	As last tooth was being removed, patient showed signs of returning consciousness by lifting up her hands, and immediately afterwards expired.	Syncope (apparently).	Had frequently had teeth removed under CHCl_3 before. Sitting posture.
411		M	Excision of tongue.	Towel.	R.	Chloroform not long given before patient's R. ceased and face became livid, and appearance was of tonic stage of epileptiform convulsion. Every measure for restoration used with no success.	Asphyxia. (Epileptiform convulsion.)	

* Case 402. Before operation was performed patient died.

* Case 403. Died while under influence of drug.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
412	17	F	Extraction of teeth.			Died while under influence of CHCl_3 .		Patient insisted upon being put under CHCl_3 against the advice of the administrators.
413		M	Re-setting of broken thigh.			During operation was seized with epileptic fit and died in a few minutes.	Epilepsy.	Sitting posture.
414	20	M	Passage of catheter.	On handkerchief formed into hollow cone.		Operation proceeding when death took place suddenly without any preliminary convulsion, "patient being completely overpowered by anæsthetic."	? Syncope. ? Overdose.	The patient was a strong healthy man, keenly sensitive to pain. Native assistant not paying attention to his patient allowed the cone to completely cover both mouth and nostrils.
415	28	M	Removal of lupoid growth from under lip.		P. & R.	Had hardly taken 2 whiffs when R. ceased and he was dead.	? Syncope. P.M. Fatty degeneration of right ventricle of heart. Death attributed to physical causes; dread of operation.	
416	35	F	Cancer of tongue.			Died before operation was commenced.	"Death from chloroform before operation." P.M. Emphysema of lungs. Dilated right heart. P.M. appearances <i>nil</i> .	
417			Extirpation of eyeball.	$\frac{1}{2}$ oz.		In about 15 minutes after first inhalation, R. became embarrassed, P. affected, patient became livid and in 5 minutes R. had ceased. Artificial R. electricity, hypodermics of brandy, ether and strychnine solution tried.		
418	32	M	Amputation of toes.	Small quantity.			Syncope.	Every care used to guard against fatal result.
419	45	M	Removal of tumour from lip.			Patient became livid. Restoratives tried but death took place immediately.	"Paralysis of the nerves causing syncope."	Administrator gave CHCl_3 prior to commencing operation without assistance of second professional attendant. Patient had taken CHCl_3 before.
420	45	M	Contracted palmar fasciæ.			Died before operation was commenced.	P.M. "Death from chloroform before operation."	
421	28	M	Urethral stricture.	On lint. 1 dr.	P.	As patient passed into final stage muscular rigidity came on, face became pale and P. lost. Inversion, artificial R. and galvanism practised. No return of P. and breathing gradually ceased.	Syncope. P.M. Tubercular disease of kidney and ureter, early tuberclosis of epididymis on both sides, with complicated stricture of urethra. Heart overlaid with fat, and muscular tissue pale.	Had taken ether 3 times before, but refused to do so on this occasion.
422	47	M	For fistula in ano.		R.	At close of operation, breathing became shallow and stopped, P. being weak, rapid, but evident. Artificial R. 1 hour 20 minutes, also ammonia, cold effusions, and galvanism. P. gradually faded, and R. never restored.	Failure of R. P.M. All organs healthy except fatty liver.	
423								No particulars
425								
426			Dressing sprain of ankle.	Few drops.		Died after a few drops had been inhaled.	"Syncope consequent on drunken habits of patient."	
427	54	M	For hernia.			Copious vomiting, failure of P.	Asphyxia, small quantity of food below rima glottidis.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	Remarks.
428 429	45	M	Strabismus. Excision of part of tongue for papilloma (5-6 minutes).	Flannel. Skimmer's inhaler.	P.	Face became livid and heart's action found to have ceased. Measures employed were: Laying patient flat, putting bolster under shoulders, artificial R., galvanic battery, cold douche to head. No good result.	Syncope	Heart examined before administration and sounds found to be normal.
430	57	M	Epithelioma in cheek.				P.M. "Emphysema. Syncope under chloroform."	
431							P.M. Heart malformed. ? Syncope.	
432	50	M	Amputation just above ankle-joint.	Towel. $\frac{1}{2}$ dr.		Patient expired after only 12 inspirations. Nitrite of amyl and ammonia, together with artificial R., used ineffectually.		
433	17	M	Exploration of ankle-joint.			Took anæsthetic well and breathed easily during operation, which lasted about 5 minutes. CHCl_3 then discontinued. Patient seemed recovering when vomiting came on. Throat cleared by fingers and tongue brought forward by forceps. By this time heart had failed. Artificial R., electricity and tracheotomy tried with no avail.	"Fatal fainting caused by administration of chloroform." No P.M. allowed. Syncope.	
434	35	F	For necrosis of tibia (supposed to be syphilitic).	Cone.	R.	P. became more rapid and less strong, muscles became rigid, and R. suddenly failed. Usual methods for resuscitation—nitrite of amyl, ammonia, reversing body, artificial R.—all employed without avail.	"Spasm of diaphragm and respiratory muscles." P.M. Heart dilated and extended with dark fluid blood and clots; large fibrinous clot extending into pulmonary artery. Lungs: old pleuritic adhesions. Brain: substance anæmic. Kidneys contracted, albuminous urine. P.M. "Death under chloroform."	Intemperate, had taken CHCl_3 four months previously with no bad symptoms. CHCl_3 on fatal occasion tested and found pure.
435	44	F	Epithelioma of tongue.				Syncope.	
436	26	M	Forcibly moving stiffened joints for fracture.	Folded towel.	P.	Patient commenced inhaling by taking several rapid shallow breaths, then followed 3 or 4 deep inspirations. Cloth was then removed, though he was breathing, eyes wide open and pupils rapidly dilating, conjunctiva insensible. Face not livid but slightly flushed, lips normal, on feeling radial no P. could be detected. Tongue withdrawn by artery forceps and artificial R. begun. Bed raised at foot, ether injection and galvanism applied. Patient made 3 or 4 Rs. but no return of P.	There was no pallor and the pink appearance at death was abnormal. Either vasomotor centre in common with cardiac became paralysed and thus blood was kept in small arteries and capillaries, or the veins contained arterial blood, from the highly oxygenised condition of blood, due to rapid R. No P.M. allowed.	Patient a strong healthy labourer. Had been in hospital 3 months laid on his back. This may have caused some organic changes leading to a fatal result.
437	28	M	Amputation through second phalanges for mangled fingers.	Napkin. $2\frac{1}{2}$ to 3 dr.	P.	Before operation begun, suddenly long stertorous R., heart ceased beating, patient became pallid, breathing ceased. Then dark venous congestion which faded away. Measures adopted were: Drawing forward of tongue by vulsellum forceps, artificial R., and heart irritated by fine aspirating needle. All efforts useless.	Cardiac paralysis. P.M. Brain slightly congested. Lungs very congested and slightly oedematous. Heart: much fat round arteries, fatty infiltration of muscular fibres.	Patient seemed 10 years older. Heart examined, no trace of organic disease, but acted rapidly and feebly. Previous history could not be ascertained.
438	33	M	Extraction of teeth.	Given in "usual way."		Patient fainted after extraction of 2 teeth. Was placed on floor and usual means taken to restore animation. Breathed 3 times after this, but death ensued.	Failure of heart's action. P.M. Heart and lungs found healthy. Primary cause probably irritation of 5th nerve which would produce slowing of heart's action and finally stoppage through pneumo-gastric nerve.	Patient not strong and had suffered much from toothache and neuralgia, but had proved himself sound in heart and lungs. Sitting posture.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
139	71	M	? (5-6 minutes).		? P. & R.	Patient ceased breathing, and attempts to re-excite heart were unavailing.		
440	56	M	Removal of tongue for epithelioma.		? R.	In the early part of administration slight hæmorrhage began and increased during the struggling of the excitement stage, which was very violent. Before operation commenced he turned pale, became suddenly livid and ceased to breathe. No respiratory movement afterwards made, though inversion and other methods of restoration used.	P.M. Right lung found generally attached to chest-walls by old adhesions; substance of heart natural and valves competent.	Patient was a man much broken down in health from alcoholism and neglect. Much hæmorrhage occurred from tongue on night after admission.
441	53	M	Incision into inflamed arm.		? P.	Soon after commencing inhalation, pulse became weak and irregular. Administration continued cautiously, but before insensibility was complete patient suddenly became faint and died.	P.M. General hypertrophy of heart with dilatation, especially on right, slight thickening of edges of cusps of mitral valve. Miliary tubercles thickly scattered throughout lungs and spleen; a few tubercles were also found beneath endocardium. Commencing cirrhosis of liver and kidney.	Was admitted on March 22, and fatal administration of CHCl_3 took place on March 29. A week earlier was operated on under CHCl_3 . Cause of admission was wound of forearm with division of ulna by circular saw. The ends of the bone were united with wire, but arm became inflamed and a second operation was necessary.
442			Removal of necrosed bone from leg.					
443		M	Injury to hand.					
444	24	M	Reduction of dislocated humerus.		? P.		? Syncope. P.M. "Slight disease of the large vessels of the heart."	
445	53	F	For abdominal section.		? P.		? Syncope. P.M. "Enlargement of heart and liver, and disease of other organs."	Before administration heart examined and found quite sound.
446	40	M	Ligaturing right carotid.			After a few inhalations of CHCl_3 it was noted that R. had ceased, though P. beating well; all efforts unavailing, and in 10 minutes heart ceased to beat.	Failure of R. P.M. Lungs much congested. Heart healthy. Innominate artery dilated into large aneurysm with no trace of its original form remaining.	Anæsthetic given and intended operation agreed upon at urgent request of patient, though the danger of both was pointed out.
447		M	For ligature of external iliac artery for femoral aneurysm.		P. & R.	Operation performed quite successfully. At termination and without warning P. and R. ceased, and all efforts to restore animation failed.	Syncope.	
448		F	For change of dressings of amputated thigh.		R.	R. ceased when operation was over.	P.M. Extensive thrombosis of part of venous system.	Extremely weak.
449								
450								
451		M	For abscess in bladder (3 minutes). Reduction of dislocated hip.		? P.	In about 3 minutes patient became pale, and it was found heart had ceased to beat. Resuscitation tried, but without avail.	Syncope.	No particulars.
452								
453		M	Injury to anal region.		P. & R.	Had only just been anæsthetised and operation just commenced when R. and circulation stopped, and the man was dead.	P.M. Lungs: tissue replaced by tuberculous masses.	It was known that the patient was phthisical but neither auscultation nor percussion revealed such extensive lesions as the autopsy brought to light.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
454		M	Thoracentesis for pleuritic effusion.			Asphyxia from beginning, turned bluish, efforts made to resuscitate him. Then cardiac syncope, heart stopping.	Cardiac syncope, not asphyxia, because by means of insufflation he respired 4 or 5 times. P.M. Gummata in kidneys, choroid plexus and lungs. Whole of one lung was seat of chronic pneumonia with greyish infiltrations. Numerous pleuro-pulmonary adhesions.	
455		F	Extraction of tooth.			Pupil became widely dilated. P. could not be felt, and face became blanched. Chair, on which patient sat, turned back, head lowered, body and limbs raised. Nitrite of amyl, artificial R.	Syncope. P.M. not allowed. ? Reflex.	Patient had taken CHCl ₃ (2 dr.) well for same operation 5 days before. Sitting posture.
456	28	M	Paraphimosis.				No P.M.	
457	59	F	Removal of tumour.			After 90 minutes, sat up, became convulsed, and fell back unconscious. Breathing went on 20 minutes, but no P.	No P.M. ? Syncope.	
458		F	Dental.					Sitting posture.
459	13	M	Dental.			Stood up after operation, and immediately fell back dead.		Sitting posture.
460		F	Dental.					Sitting posture.
461	47	M	Examination for injury to knee (4 minutes).		? R.	Breathing suddenly stopped. Artificial R. and usual restoratives used for 2 hours without success.	Paralysis of heart. P.M. Heart in state of marked fatty degeneration.	Patient had good regular P., and stated had always been strong and healthy. No particulars.
462							? Syncope.	Anæsthetist knew that patient had diseased heart but CHCl ₃ had been formerly used with no ill results.
463	48	M	Amputation at patella for gangrene and blood-poisoning.			Embarrassed breathing came on soon after beginning of operation.	P.M. Old standing disease of heart and fatty degeneration of heart, liver and kidneys.	
464	43				? P.		"Cardiac syncope. Chloroform administration." No P.M.	
467	54	M	For long standing disease.		? P	Immediately on completion of operation heart's action found to have ceased. An ounce of brandy given $\frac{3}{4}$ hour before administration.	Syncope.	Examination of heart before administration gave no evidence of disease. Patient had successfully undergone similar operation 25 years previously.
468		M	Reduction of dislocation of right shoulder.			After reduction of dislocation patient gave 3 deep Rs. and death took place, all attempts at resuscitation failing.	Syncope (apparently). No P.M.	As far as could be ascertained patient's heart organically sound.
469	30	M	For false ankylosis of finger-joints (4 minutes).	Napkin. Slight dose.	R.	R. ceased. The most active efforts failed to resuscitate him.	P.M. Fatty heart and liver. Diseased kidneys.	
472	35	M	For empyema following pleurisy of right side.	2 dr.		After administration sank rapidly.	Asphyxia.	
473	32	M	Incision for glandular abscess of right sub-maxillary region.	Esmarch's open inhaler. 2 dr.	? P.	Patient struck out wildly with arms, became stiff in opisthotonos, face became livid and distorted, pupils widely dilated, abdominal muscles rigid. P. ceased suddenly, patient turned lax and was dead. All efforts at resuscitation employed for 45 minutes of no avail.	? Syncope.	Patient's heart carefully examined before operation. P. good except just before operation when weak and rapid. Suffered from nervous depression. CHCl ₃ used unexceptionable.
474	41	F	Incision for pleurisy with effusion of left side.	2 dr. (about.)	P.	Before the administration was completed P. stopped, and heart ceased beating in 5 seconds. Artificial R. performed, patient breathing, but no return of P. Fluid drawn off, and various means used with no effect.	Syncope. P.M. Heart fatty and empty.	

* Case 465. No particulars.

* Case 466. For cancer in mouth.

† Cases 470 and 471. No remarks.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
475	14	M	Removal of diseased bone from leg.		? P.	Became faint, and action of heart ceased when operation half completed.	Syncope. P.M. Liver and lungs much congested, owing, probably, to action of CHCl_3 .	Had undergone similar operation successfully before.
478	30	M	Removal of a piece of necrosed metacarpal bone.	On lnt. 2 dr.	P. & R.	Operation just commenced when P. became flickering and R. shallow.	Syncope. P.M. Heart: right auricle much distended with blood; valves healthy; muscular substance brown; walls thin and fatty. Pleuritic adhesions.	
479	45	M	Removal of epithelioma from tongue (5 minutes).	1½ dr.	P.	P. fluttered suddenly and became imperceptible. R. impeded. Artificial R. (Silvester's method) begun. Patient breathed once or twice but no heart sound heard. For ½ hour every effort made with galvanic battery, ether injections, and nitrite of amyl to nostrils.	Syncope. P.M. Heart substance yellowish-brown; tissue friable; cut surface appeared granular; walls on right side thin, almost transparent, large deposit of fat globules in muscular fibres; valves healthy; aorta sacculated and atheromatous. Lungs emphysematous.	Careful examination of chest had been made before administration.
480	28	M	Drainage of chest for pleurisy with effusion.		? P.	During last steps in operation symptoms of syncope suddenly developed, and all efforts to restore patient proved unavailing.	Syncope.	

Case 481. An operation "on thumbs."
Case 482. Operation for swelling in ankle and calf. Was completed when deceased ceased to breathe (5 minutes).
Case 483. Operation for examination of sinns in loin. The patient was seized with syncope before operation was complete, and died in a few minutes.
Cases 484, 485, and 486 call for no remarks, except that the latter was a case of removal of navus.
Case 487. Syphilitic shrinkage. After a few inhalations patient fell down dead.
Case 488. Tracheotomy. Patient, who had complete calcification of the thyroid gland, swallowed an enormous quantity of blood.
Case 489. Cancer. Immediately CHCl_3 administered, patient fainted and died. Had previously undergone operation for cancer under CHCl_3 successfully.
Case 490. Abscess in neck. Patient died almost immediately CHCl_3 was given.

491	34	M	Incision in abscesses in arm.	Metal inhaler. Lint lining. 2 dr.	? R.	Revived after having seemed to be fully under. Inhaler reapplied and no more given. Incision made, and suddenly breathing stopped. Neck and face became cyanotic. The head was lowered, the tongue pulled forward, and artificial R. begun, after which several long Rs., cyanosis continued. Incision did not bleed. Breathing again stopped. Artificial R. and flipping with cold and hot water towels, hypodermic of ether in thigh 20 minutes, and faradism, all failed to resuscitate. During artificial R. no beats of heart, and pupils dilating.	Failure of heart. P.M. Heart filled with blood, oedema of pericardium covering first part of aorta, walls soft and patulous, but not breaking down with finger nail. Walls of auricles much thinner than usual. Endocardium and pericardium in contact. Mitral valves slightly affected.	Was well developed, fairly good health though weakened by state of arm, and had become slightly in temperate, had fractured both bones of forearm, compound, 2 or 3 months earlier, with laceration of soft parts, and had been treated successfully under chloroform.
492	26	M	Closing of fistula after extraction of urethral calculus.	Skinner's inhaler. 1 oz.	P.	When operation nearly completed, patient became sick, and P. then stopped. Usual means for resuscitation.	? Syncope. P.M. Heart empty, muscles thin and flabby, no valvular disease.	Had taken CHCl_3 well for extraction of calculus.
493	45	M	For malignant growth at back of pharynx (2½ minutes).	Junker's inhaler. 1½ dr.	R.	Before operation was begun patient stopped breathing and became livid in face, heart continued to beat. Efforts were made to restore R., but heart ceased beating 2 minutes after R. stopped.	Arrest of R. caused by new growth occluding aperture of larynx. P.M. New growth from right and upper pharynx involving palate and right side.	Patient had been very healthy till 4 months previously, when he began to suffer from dysphagia, pains in head, and had fetid discharge from mouth.

* Case 476. Opening an abscess, and P.M. showed that the heart was structurally healthy.

* Case 477. For injury to hand.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
494	42	M	Amputation of finger for cellulitis after injury.		P.	During inhalation patient began to struggle violently and P. became feeble. Anæsthetic suspended, but P. became imperceptible. No return of P. although some slight automatic breathing took place after P. had ceased.	Syncope. P.M. Heart: extreme fatty degeneration, much dilated. Valves healthy. Kidneys cirrhotic and cystic.	Fairly robust and seemed in average health. Heart auscultated, and no murmur heard. Had had two other fingers lately removed under CHCl_3 .

Cases 495 to 505 have no comment. Case 505 was a case of extraction of teeth.

Case 506. Strangulated umbilical hernia. P.M. Fatty heart. Case 507. Pus in pelvic tissues.

Case 508. Cellulitis. Death just after completion of operation.

Case 509. Obstetrical. P.M. Fatty degeneration of heart.

Case 510. No remarks.

Case 511. Enucleation of eye. Just before completion of operation patient recovered consciousness; few more whiffs of CHCl_3 given, when heart ceased beating. Every effort made to resuscitate without success. P.M. Heart, right side dilated, though valves normal.

512	30	M	Amputation of injured fingers.	$\frac{1}{2}$ ordinary quantity.	P.	As operation was about to be commenced P. ceased. Artificial R. tried. Patient breathed once or twice, but did not revive.	Syncope. P.M. Heart, though not diseased, very flabby.	Patient's chest carefully examined before administration, and no signs found of heart being affected.
513	38	M	Fungous synovitis of extensors of left fingers.	"Pseudo-chlorure de méthylène" (compress).	P.	Patient much agitated, was ready for operation in 2 or 3 minutes. All went well at first, R. being normal, but when Esmaich's bandage was applied, patient had fit of violent excitation and struggled without crying out. R. remaining difficult. Tongue was drawn forward with forceps. Face congested. Chloroformisation had been stopped some minutes. P. ceased, there were 2 or 3 stertorous R., pupils were dilated, and there were no corneal reflexes.	Cause could only be conjectured—probably paralysis of heart.	
514	56	M	Removal of anterior part of tongue and jaw (epithelioma).	Junker's inhaler.	R.	Operation nearly concluded, little blood lost; P. good. When CHCl_3 resumed, patient became cyanotic and R. stopped. Stump of tongue dragged forward—one deep inspiration. Attempt to catheterise larynx—another deep gasp. Artificial R. maintained and laryngotomy performed with no effect.	Failure of respiration. P.M. Practically healthy heart muscle. Extensively adherent pleuræ.	Powerfully built, habitual drunkard. Said to have had acute Bright's disease with extensive œdema, but free from albuminuria at time of operation. Heart sounds normal at operation.
515	36	M	P	3 dr.		Struggled violently and expired quite suddenly.	Syncope. P.M. Malformation of heart and extensive kidney disease.	

Case 516. Removal of calculus. During the operation a change in P. was perceived. Artificial R. for more than $\frac{1}{2}$ hour without avail.

Case 517. Extraction of teeth. Before patient had drawn her breath half a dozen times she slipped from her chair and expired almost at once. Syncope brought on by excitement.*

Case 518. Hip-joint disease. Died after inhaling the anæsthetic 15 minutes. P.M. Fatty degeneration of heart, liver, spleen, and kidneys.

Case 519. Amputation of thumb. Before becoming fully anæsthetised patient collapsed and died. Syncope. "Fatty degeneration of heart" cause of death.

* Sitting posture. See also Brit. Med. Journ., October 5, 1889, p. 778, where a case is also recorded of a female insisting on taking CHCl_3 for extraction of teeth. The dentist pretending to comply with her wish gave her eau-de-Cologne. After 2 or 3 inspirations she fell from the chair and died. This took place in Germany.

SERIE B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
520	41	F		Junker's Inhaler.	P. & R.	When half way through operation, R. and heart's action ceased, and pupils became widely dilated.	Syncope.	
521		M	Reduction of dislocation of right shoulder joint.					
522	65	M	Exploratory for tumour in abdomen.		P. & R.	Before operation was begun, patient gave 1 or 2 gasping inspirations and ceased breathing and heart stopped. Every effort for restoration made without avail.	? Syncope. P.M. Heart healthy. Malignant disease of stomach.	Heart carefully examined before administration.
523	24	F	Operation for lupus of face. (7 or 8 minutes)	Skinner's Inhaler. $\frac{1}{3}$ dr.	R.	At beginning of operation as signs of returning consciousness were seen more CHCl_3 given. Then patient suddenly stopped breathing. Tongue drawn out with forceps and artificial R. for $\frac{1}{2}$ hour (Silvester's method). Galvanic battery and nitrite of amyl inhalation.	Asphyxia; heart having ceased to beat, subsequently to respiratory failure. P.M. Heart sound.	Patient in good health, had no cardiac or respiratory disease. Had taken CHCl_3 five times previously for similar operations.
524	39	M	Removal of tumour from back of shoulders.	2 dr.	P. & R.	Patient took CHCl_3 readily, was turned on side. R. ceased and heart also, at same time face became cyanosed. Artificial R. and inversion resorted to.	"Paralysis of laughs." P.M. Fatty heart but no valvular disease.	Patient had undergone operations for similar growths. Examination before this administration led to conclusion that patient "had weak heart but no valvular disease."
525	56	M	Reduction of fracture of femur.			Patient succumbed before reduction could be made.		
526	30	F	Removal of small subcutaneous fatty tumour of face. Examination of intestinal obstruction.	On diaper. About from 2 to 3 dr.	R.	Cutting had just begun when R. suddenly stopped. Heart beat first well then feebly for 2 minutes after R. ceased.	Failure of R. P.M. Heart quite sound, no fatty degeneration.	Heart, lungs and other organs seemed quite sound before administration.
527				$1\frac{1}{2}$ dr. (Towel.)	P. & R.	No alarming signs while abdomen was explored. After injection of $\frac{1}{2}$ pint of soap and water into bowel, face turned blue and breathing ceased, the child's body also having been raised. Artificial R., inversion, flicking with wet towel, tried for 35 minutes. Heart stopped with R.	"Reflex shock producing paralysis of respiratory and cardiac centres." P.M. Intestines: obstruction caused by hand compressing duodenum. No peritonitis or inflammation. Lungs congested, containing air. Heart: walls and valves healthy. Both sides empty and contracted.	Had had trouble with bowels since birth. Bowels had not been moved for 14 days.
528	9	M	For rupture of right eye.			Patient seemed to have recovered when he suddenly turned pale and faint. Every possible remedy applied without avail.		
529	60	F	Amputation of finger of left hand.		R.	R. ceased immediately CHCl_3 was given. All efforts at resuscitation unavailing.	Failure of R.	
530		M	Removal of tumour in throat.			Death ensued before operation took place.	Death ensued from effects of CHCl_3 .	
531	51	M	Probing of abscess of thigh.			Death ensued before patient fully anæsthetised.	P.M. Heart healthy, but poorly nourished.	Had been operated upon successfully under CHCl_3 about 10 days previously. See also Brit. Med. Journ. Oct. 4, 1890, p. 789.
532	36	M	For fracture of patella.	150 grammes.		The operation was performed, and the patient so far recovered. Was slightly delirious for 2 nights. On 3rd day wound looked well. Temperature $100^{\circ}50$, P. 96. Rather feeble. In course of evening P. grew weaker, delirium increased, and patient died.	"Fatty degeneration of heart actually caused by anæsthetic." P.M. Muscular walls of heart in state of extreme acute fatty degeneration; similar change had attacked fatty cells. Prof. Thiem and Fischer observed similar changes in	Patient robust and temperate; miller's man; accustomed to carry weights, till day he broke patella. No previous evidence of any form of heart disease.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
533		M	For rib resection for pyopneumothorax.		P. & R.	Pupils suddenly dilated, heart and R. ceased almost instantaneously. Restorative measures unavailing.	heart and liver of animals kept under CHCl_3 , especially when dose was repeated for 2 or 3 days. Syncope; death being accelerated by diseased condition of lungs.	Had taken CHCl_3 for same operation several times before.
534	40	M	Opening up fistula in perinæum.		P.	Became very excited and face suffused; P. became weak, then stopped altogether, though breathing good. CHCl_3 at once removed; breathing failed after 45 seconds. Artificial R. and other means used without avail.	Cardiac syncope, owing to strain put upon heart. P.M. Heart: valves healthy; walls of right ventricle rather thin. Lungs infiltrated with tubercle. Liver slightly fatty.	Intemperate.
535	10	?	For knock-knee.		? P.	At end of operation child suddenly became faint and in dangerous condition. Artificial R. was tried, natural breathing resumed, but heart still failed. Injections of ether tried, but useless.	Syncope.	Patient had been examined before administration and found healthy.
536	64	M	Reduction of dislocation of thigh.		P.	Heart suddenly stopped. Operation had been performed.	Syncope. P.M. Heart with very thin walls.	Examination of heart before operating gave no evidence of disease.
537		M	For enucleation of eye.			Died under anæsthetic.		
538		M	Suturing fractured patella.	Inhaler, $1\frac{1}{2}$ dr.	P.	Within $\frac{1}{2}$ minute of loss of consciousness heart ceased to beat, and death took place in spite of all efforts at resuscitation.	Syncope. P.M. Fatty degeneration of heart.	
539	24	M	For urethrotomy for urethral stricture.	Small dose.	P. & R.	R. and circulation stopped at same moment. Artificial R. tried and continued for $\frac{3}{4}$ hour with no result.	Assumed that death due to shock caused by incision, weakened by leucæmic discrasia.	
540	7	M	Amputation of thigh.			Death took place before amputation completed.		
541	72	F	Removal of glaucomatous eyeball.		? P.	Died whilst under the influence of the anæsthetic.	Syncope. P.M. Heart weighed 14 oz. and was fatty.	
542	13	M	Putting up diseased ankle in splint.			Died under chloroform.	P.M. Heart greatly dilated and hypertrophied without apparent cause. Weighed more than that of a child of 3 years old.	
543		F	Excision of mole from cheek.			After operation no return to consciousness, and when measures for resuscitation were taken patient was seized with a convulsion and expired.		
544	46	M	On arm. (9 minutes.)	1 dr. Esmarch's Inhaler.	P. & R.	Breathing became stertorous and heart's action and R. ceased. Operation had been begun. Ether and brandy injections, galvanic battery and artificial R.	Syncope. P.M. No evidence of organic disease in heart. Liver: slight fatty degeneration.	
545		M	Reduction of dislocation of shoulder.			Patient succumbed during manipulation of joint.		
546	20	F	Examination for obscure affection.		P.	Before anæsthetic stage was reached, P. became weak and patient expired.	? Syncope.	
547	17	M	Exploratory incision over right hypochondrium.	Wire and lint mask. 6 dr.	P.	Soon after administration marked diminution in P. beats, but they soon became stronger and breathing regular. In 20 minutes face became pallid, P. stopped, and breathing irregular and gasping.	"Reflex paralysis of heart." No P.M. allowed.	Had suffered for 6 months from colic of uncertain origin, for which hypodermics of morphia had been used and in increasing doses.
548	11	F	Removal of nævus.	Esmarch's Inhaler.	P. & R.	Operation almost performed when general convulsions came on; breathing and heart beat ceased, a few gasps and patient was dead. Measures resorted to were: Artificial R., ether, whisky and nitrite of amyl injections, and electricity.		

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
549		♀ F	For mammary abscess.					
550	60	M	Amputation of arm for injury caused by burn.			At commencement of operation epileptic seizure took place and patient died.	Syncope and epilepsy.	Patient was epileptic.
551	28	M	For fracture of ankle.					
552	9	F	For iridectomy.		R.	Recovery had to some extent taken place when breathing stopped, extreme sudden pallor. Inversion, ether injection, brandy and battery tried, and artificial R. kept up for 2 hours, all with no effect. Patient not deeply under CHCl_3 .	Syncope. P.M. Apparances <i>nil</i> , except adherent pleurae.	
553	49	F	For drainage for empyema.		? R. P.	After a few inhalations breathing became suddenly irregular and then ceased. Artificial R. kept for $\frac{3}{4}$ hour without result.	P.M. Heart in advanced state of fatty infiltration. Collection of fetid pus in right pleura, and lower part of lung gangrenous. Syncope.	Intemperate. Had pneumonia of right base.
554	30	F	Plastic operation on face for restoration of nose.	Quantity not measured but not excessive.	P.	Patient had just become unconscious when P. ceased, though R. quite regular and not stertorous. In a few seconds breathing failed. Artificial R. for 1 hour failed to restore action of heart and R.		Before administration no evidence of disease beyond enlarged spleen. Heart and lungs healthy.
555		M	Harelip.			"Death under CHCl_3 ."	Shock.	
556	49	M	For œdema and stiffness of left hand after a Colles' fracture.	1 or $1\frac{1}{2}$ dr.	P.	Patient's face became somewhat dusky. P. failed. After 4 or 5 deep gasps R. stopped. Artificial R. for $\frac{1}{2}$ hour, and ether injections over heart, without avail.	? Syncope. P.M. $\frac{3}{4}$ inch fat over chest, lungs emphysematous; some unneo-pus in bronchi. Heart loaded with fat on surface; no fatty degeneration. Syncope (apparently). P.M. Body emaciated. Heart dilated with thin walls; only one coronary artery. Cavities in apices of both lungs.	Patient subject of chronic bronchitis, otherwise healthy.
557	30	F	Removal of ovarian tumour.	Junker's Inhaler.	? P.	Patient had only been inhaling 2 or 3 minutes, when she gave deep sigh, turned very pale, with dilated pupils, and expired. All restorative measures and artificial R. for $\frac{1}{2}$ hour.		
558	36	M	For varicose veins.		? P. & R.	Struggled violently, CHCl_3 discontinued; turned pale and ceased breathing. Artificial R. begun but patient turned livid and did not breathe again. P. not perceptible. Not certain whether it stopped with breathing.	Syncope, induced by (1) struggling of respiratory and other muscles; (2) small dose of CHCl_3 ; and (3) malnutrition of heart, liver, kidneys and brain.	Appeared in robust health.
559	44	M	Removal of dead bone in case of abscess of right thigh and disease of thigh and bone. (Under 5 minutes.)	1 dr.	?	After inhaling less than 5 minutes, patient began to struggle, face became dark and congested. All measures possible used to restore without success.	"Death from effect of CHCl_3 on lungs and then on heart, through nervous system, which seemed weakened from excessive drinking."	Two months previously patient had undergone similar operation under 8 dr. CHCl_3 given over period of $\frac{3}{4}$ hour.
560	25	M	For empyema.			Patient succumbed in 4 minutes after beginning to inhale.	Syncope.	Patient in a very weak state, but wishing to have chance of operation.
561	58	M	Opening chest to evacuate empyema.		R.	Patient had only inhaled from $\frac{1}{2}$ to 1 dr. CHCl_3 when breathing ceased. Artificial R. re-established breathing. Operation undertaken and nearly 1 quart of pus discharged. But P. feeble and no return to consciousness. Brandy given by mouth and swallowed. Pupils dilated but sensitive to light. Died in $1\frac{1}{4}$ hours.	Cardiac syncope. "Chloroform acting on already enfeebled circulation caused depression. Probably also shock caused by removal of accumulated fluid from thorax."	Healthy man till 5 weeks previous, date of beginning of illness. No cardiac murmurs.
562	$1\frac{1}{2}$	F	Application of nitric acid to noma of hard palate and upper lip.	Guy's mask.		Anæsthetic taken well, insensibility in 4 minutes. Operation about to be begun when temporal P. became feeble, R. slow and sighing, slight pallor. Artificial R. begun before natural breathing ceased and carried on for $\frac{1}{2}$ hour. Galvanism, hot fomentations, elevation and friction of lower extremities also tried—of no avail.		No evidence of cardiac disease. Ailing child since birth.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
562 564 565	?	?	For strangulated hernia; tracheotomy also performed.			Vomit entered the trachea.	{ "Death due to chloroform pure and simple" [?] overdose]. Asphyxia.	A "remote death."
566	27	M	Amputation of fore-arm.			Recurrent hæmorrhage made re-amputation necessary. While under CHCl_3 patient vomited, portion of vomit, "pulp of orange," entering windpipe. Tracheotomy performed. Patient survived 5 hours and died suddenly from syncope.	Syncope.	A "remote death."
567	14	F	Forcibly moving knee after osteotomy.			Symptoms resembled those of severe shock.		
568	25	F				Patient is said to have fainted during administration. All measures adopted proved futile.	Cardiac syncope.	
569	41	M	For cancer of tongue.	Skinner's apparatus.		Gave but 2 or 3 inspirations when he died suddenly as if shot through the heart. Every endeavour to restore consciousness failed. Breathing not impeded. No pallor.	Failure of heart's action.	Had undergone operation under ether 4 days previously. Examination of heart previous to operation disclosed nothing the matter.
570 571		F			R.	Almost immediately after CHCl_3 had been given breathing ceased. Measures adopted not stated.	Syncope.	
572					R.	R. ceased and inhalation was at once stopped.		
573	44	M	Removal of fibrous tumour of right patella. (6 minutes.)	$2\frac{1}{2}$ dr.		After patient was fairly under and small incision made, pupils became dilated suddenly and breathing shallow.	Syncope.	
574							"Failure of R."	Patient was in a state of partial recovery from bronchitis when CHCl_3 given.
575 576								
577	30	M	To open abscess in neck.			Almost as soon as he was under the influence of the anæsthetic he turned pale and in spite of every effort at resuscitation he died.	Syncope. P.M. Heart and lungs perfectly healthy, only small quantity of fluid in stomach.	A healthy young man.
578		M	For fistula in ano.			Patient took anæsthetic and was quickly under its influence. Inhalation stopped and patient turned over on right side. It was then seen that he was not breathing.	? Syncope. P.M. Left ventricle of heart found to be dilated and in a state of fatty degeneration. The right side of the heart and the veins full of blood. Exhaustion.	Patient had had ague. Examination of heart beforehand discovered nothing.
579		M	Opening abscess in jaw after extraction of tooth.		R.	Breathing suddenly ceased, was restored by artificial R. and other measures, heart keeping good. Violent convulsions set in, and death occurred in $\frac{1}{2}$ hour from exhaustion. Operation had been performed.		
580	33	M				During the struggling stage the cardiac action failed and the man died in a few seconds.	Syncope.	
581	14	M	Amputation of fore-arm.				P.M. Lungs: double pleurisy. Heart: mitral and aortic incompetence. No fatty degeneration. Kidneys: very cystic, containing 32 oz. fluid.	

Case 582. For cleft palate. After CHCl_3 had been given, showed signs of returning consciousness, operation not being commenced. More CHCl_3 given. Ceased breathing, and though artificial R. resorted to, suddenly expired.

Case 583. For piles. Chloroform, which was pushed no further than producing analgesic effect, was taken well by patient. Suddenly patient succumbed. Resort had to artificial R., but all efforts futile.

Case 584. Removal of 3 teeth. Patient died during operation.

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1 Reference.	2 Age.	3 Sex.	4 Operation and duration of administration.	5 Method of administration.	6 P. or R.	7 Symptoms occurring under anæsthetic.	8 Assigned cause of death.	9 Remarks.
585	14	M	Trephining for injury to head.			About 10 minutes after the operation had commenced patient became faint and his breathing ceased. Attempts were made to restore R. and were to some extent successful, but the heart's action suddenly ceased.	Syncope. P.M. Brain was lacerated, quantity of blood near the wound.	
586	62	M	Hæmorrhoids.			When operation about to be begun patient's face became blue and breathing ceased.	Failure of heart's action.	
587	11	M	Extraction of roots of teeth in case of alveolar abscess.	(Towel.)	P.	The roots of one tooth had been successfully extracted and a little more chloroform was given to extract two other decayed teeth, when patient suddenly turned pallid, breathing continued, but P. lost.	Syncope.	Sitting posture. Had suffered from a decayed tooth in left inferior maxilla which set up alveolar abscess. Two unsuccessful attempts had been made to extract the roots, on previous occasions, by a dentist other than the one who extracted them.
588	39	M	To relieve urgent symptoms (? in what). (10 minutes.)	Inhaler. (Wire cage with flannel.) 2 dr.	R.	Was being turned over when he gave a gasp and ceased breathing. Was laid across bed and artificial R. (Sylvester's method) commenced and kept up for 1 hour with no effect.	No P.M.	
589	42	F	Reduction of dislocation of shoulder some months old.	Flannel Inhaler.		Soon after commencement of inhalation patient became very excited, chloroform being continued but not pushed. Soon became quiet and then at once stopped breathing. Anæsthetic stopped.	P.M. Heart: right ventricle distended with fluid blood; left contracted in systole; muscle pale and fatty. Lungs: congested and œdematous.	
590		M	For varicose veins.	20 or 30 drops on lint.	? P.	Breathing became shallow and face pale; P. fair and reflexes persisting. Condition became rapidly dangerous. Restorative measures used.	Syncope.	Seemed organically healthy, although ill-looking and anæmic.
591	21	F	Abscess (less than 5 minutes).	Teaspoonful given in ordinary manner.		Died at a moment's notice.	Syncope and "not from chloroform."	Robust.
592	27	M	Licising leg to let out pent-up pus (sloughy cellulitis over left shin).			Breathing became slow and gasping; tongue pulled out but symptoms became worse. No P. could now be felt. Ammonia applied to nostrils, hypodermic of sulphuric ether (2 dr.); battery to nape of neck, and alternately over phrenic nerves and præcordium. Artificial R. (Sylvester's method) employed from beginning of alarming symptoms, patient only gave few gasps. Measures discontinued after 1 hour. At beginning of bad breathing, pupils moderately contracted but quite insensible to light.	Syncope. P.M. Heart sound as to valves, but very thin-walled, soft and fatty. Liver large and fatty.	Fairly healthy-looking, but it was afterwards ascertained that he had been "living on drink for several days," though said to have been only moderate drinker.
593	37	F	Putting splint on arm that had been fractured.	Folded lint.	P.	Before splint could be applied P. suddenly failed and R. became sighing and irregular, and in spite of hypodermics of brandy and artificial R., no rally could be induced.	? Syncope. P.M. Body fat, with signs of alcoholic excess and venereal disease. Heart large, pale, contracted, with dark fluid blood. "Paralysis of R." P.M. Organs all healthy.	
594	36	M	Removal of lipoma over left iliac crest.	(Towel.)	R.	Struggled at first. Directly relaxation came on, towel was removed and he had no more CHCl ₃ . Was turned on right side still breathing well. Just before commencement of operation breathing ceased suddenly. Tongue well out but pulled more forward with forceps, and artificial R. started which was continued for almost 1 hour. Nitrite of amyl, hypodermics of ether, and battery used without any response.		Was strong and robust, with good, full and regular P. It was found out after his death that he had taken CHCl ₃ before, and badly, had been dreading this operation for some time.
595	?				P.	Attack of syncope came on during administration of chloroform. R. continued after heart had ceased to beat.	Syncope. P.M. Hypertrophied heart with dilated left ventricle; no valvular disease or malformation.	

SERIES B.

DEATHS UNDER CHLOROFORM.

CASES BETWEEN 1860 AND 1891 FROM PUBLISHED RECORDS (*continued*).

1	2	3	4	5	6	7	8	9
Reference.	Age.	Sex.	Operation and duration of administration.	Method of administration.	P. or R.	Symptoms occurring under anæsthetic.	Assigned cause of death.	Remarks.
696	68	M	Removal of folds of false tissue about anus. (Rather over $\frac{1}{2}$ hour.)	Skinner's inhaler.	P. & R.	Patient went easily under. About 5 minutes after operation 2 oz. of fluid with small milk-cards vomited. Radial P. and R. ceased together; pallor of face and hands.	P.M. Nothing abnormal seen about the heart. Brain normal. Veins of pia mater excessively engorged and all the viscera dark engorged with blood.	

SERIES C.

DEATHS RECORDED IN REPLY TO THE LANCET SPECIAL INQUIRY.

SERIES C comprises a number of fatalities under chloroform which were reported to the LANCET through the medium of the special enquiry form issued by the LANCET to the hospitals as well as to practitioners. As we had occasion to mention above, most of the cases which were originally comprised in this Series, were also reported in the medical journals, and where this was the case we have allowed the reports to appear among the deaths occurring between 1848 and 1864, or among those deaths reported in the journals which took place between 1864 and 1891, and have excluded them from the present series. The first section deals with reports of cases received from hospitals, and the second with those which have reached us from private practitioners.

I.—HOSPITALS.

- 1.—Male, aged 35. Tracheotomy for diffuse inflammation round larynx (1 minute). Chloroform given, flannel on wire frame. Respiration failed first.
- 2.—Female. No particulars given.
- 3.—Male, aged 42. Incision into thumb. Died before operation.
- 4.—Male, aged 40. Abscess in neck. Had mitral disease.
- 5.—For empyema. Pupils dilated and heart suddenly failed. Syncope.
- 6.—For phimosis. Before operation could be begun, death occurred suddenly. Syncope.
- 7.—Male, aged 15. Removal of left eye. Epileptiform seizure on right side and death. Cause assigned for death, "central epileptiform attack."
- 8.—Male, aged 8. For contracted fingers from old burn. Chloroform given (on lint) 1 dr. Pulse and respiration ceased simultaneously. "Pallor, blue lips and cheeks, pupils dilated to the full. Respiration did not completely cease. Measures used were: Drawing out tongue with forceps, raising legs, artificial respiration, faradic current. Air entered chest, but no pulse felt." "Death due to syncope. Post-mortem. Heart: right side full of dark fluid blood; left, contracted and empty. Other organs healthy. Patient well developed."
- 9.—Male, aged 60. Reduction of Pott's fracture (3 days old). (10 minutes). Chloroform (towel). Post-mortem. Advanced degeneration of heart. Hard drinker.
- 10.—Male, middle-aged. Forceful catheterism (a few seconds). Chloroform (Skinner's inhaler). Respiration failed first. Death probably due to effects of chloroform, and uræmic poisoning. An intemperate seafaring man with almost complete urethral stricture.
- 11.—Male, aged 38. For dislocation of shoulder. (Skinner's inhaler). Respiration failed first. Patient fully under chloroform 1 minute, when signs of asphyxia appeared, then pulse stopped suddenly; but patient breathed twice after. Dorsal decubitus adopted. Measures of resuscitation were—(1) artificial respiration; (2) raising legs; (3) hypodermic ether; (4) cold affusion; (5) nitrite of amyl; (6) forcible traction on tongue. Post-mortem. Well marked signs of death from asphyxia; venous engorgement of brain and meninges. Heart very flabby, great loss of muscular tone, no fatty degeneration, right side of heart full of blood.
- 12.—Male, aged 25. External urethrotomy; several minutes. Respiration failed first. Patient was thoroughly anaesthetised. Cause assigned for death, "Asphyxia, due to overdose of chloroform."
- 13.—Aged 10½. Necrosis of os calcis. No particulars.
- 14.—Psoas abscess, incision and drainage. Pulse failed first. "Death from sudden cardiac failure."
- 15.—Male, aged 40. Breaking adhesion in knee-joint (5 minutes). (Junker's inhaler.) Respiration failed first. Inhaler removed, and operation begun, when respiration suddenly stopped, face became cyanosed. Measures adopted for resuscitation were:—drawing forward tongue; opening windows; artificial respiration; application of hot flannels to heart; and injection of ether. Despite all efforts, he never rallied. Heart stopped almost directly after respiration. Post-mortem. Heart: surface was more fatty than normal, though patient a spare man; walls of both ventricles thin and pale, muscular tissue at apex of right ventricle less than $3\frac{1}{2}$ inches thick.
- 16.—Female, aged 10. Exploration of hip. Anaesthetic given by house-surgeon. No particulars.
- 17.—Female, aged 16. Necrosis of tibia. No particulars.
- 18.—Male, adult. Removal of carious bone from finger. Chloroform on folded towel. Pulse failed first. When fully under, pulse became weak. Towel was at once removed. As respiration was good the incision was made, but it was noticed that very little blood flowed. Patient showing signs of returning consciousness, towel was again applied, without any additional chloroform. He inhaled a few times, and then respiration suddenly stopped. Post-mortem. *Rigor mortis* well marked. Cicatrices on right side of thorax, showing old-standing disease of ribs. Heart: rather small, pale, and friable; right side contained small quantity of dark venous blood. Microscopically: the muscular tissue of the heart was distinctly fatty. Right lung was intimately adherent to the costal pleura.
- 19.—Male, aged 28. Fistula. Post-mortem. Extensive pleural adhesions. Perforation of one lung, with collapse, result of superficial abscess.
- 20.—Male, aged 30. Excision of left shoulder; $\frac{3}{4}$ hour. Chloroform given by a student. Pulse failed first. Heart stopped suddenly just when a slight effort was being made to relax the bared head. Syncope. "The drag upon the brachial plexus probably as much the cause of death as the chloroform."
- 21.—Male, aged about 40. Incision and removal of facial tumour (sarcoma). Pulse failed first. After about six respirations patient started up, was held, towel with chloroform being still over face. While half sitting, fell back, having taken one breath; the heart seemed to have suddenly stopped. Died at beginning of 2nd stage, after the heart had stopped. Post-mortem. Cadaveric rigidity well marked. Lungs: healthy but congested. Heart: 22 oz.; cavities much dilated; left auricular ventral orifice admitted three fingers, mitral cusps slightly thickened at margins; lining membrane at arch of aorta atheromatous. Physical examination revealed presence of some cirrhosis of liver and a soft blowing murmur over mitral area of heart.
- 22.—Female, aged 15. Excision of elbow; 20 minutes. No particulars.
- 23.—Male, aged 13. Amputation at wrist; 40 minutes. No particulars.
- 24.—Male, aged 43. Exploration of caries of rib; 10 minutes. No particulars.
- 25.—Male, aged 59. Radical cure of hernia; on a towel. Became suddenly livid and limbs rigid, breathing shallow and heart weak, followed by death.
- 26.—Male, aged 14. Dislocation of elbow-joint; folded towel. Respiration failed first. After operation before consciousness returned, vomiting caused obstruction to respiration and death followed.
- 27.—Female, aged 36. Ovariectomy; only 1 or 2 whiffs. Respiration failed first.

PRIVATE PRACTICE.

- 1.—Female, aged 40. Entropion. Pulse failed first. Patient was just under the influence of the anæsthetic when the face became livid. Had been taking a good deal of alcohol and little food for some time before the operation.
- 2.—? Aged 35. Finger (amputation). Duration of anæsthesia, under 3 minutes. Heart failed before respiration.
- 3.—Female, aged 30. Labour (puerperal convulsions). No particulars.
- 4.—Incisions for pyæmia. No particulars.
- 5.—Patient, a European. For pythorax. Respiration failed first.

- 6.—Male, aged 50. Stone in ureter. Chloroform (on towel).
- 7.—Male, aged 40. Tracheotomy (cancer of larynx); 2 minutes (perhaps less). Chloroform on flannel on wire frame. Respiration failed first. Patient started up as if choked on first inhaling chloroform. The administrator was then told to give the chloroform slowly; suddenly respiration ceased, pulse still flickering. Immediately after breathing ceased. The trachea was opened, and artificial respiration kept up $\frac{1}{2}$ hour. Patient breathed twice imperfectly but never rallied. The cause of death was assigned as "mechanical obstruction to respiration" interfering with adequate breathing while inhaling the chloroform. Post-mortem. Engorged lungs, besides cancerous larynx.

DEATHS REMOTELY DUE TO THE ANÆSTHETIC.

We have next to consider a series of cases in which death occurred as a result of chloroform, or presumably from that cause, but under circumstances which make it impossible to say that the anæsthetic stands immediately in casual relation to the fatality. These deaths have been classed as "remotely due to the anæsthetic." They include cases occurring from 1843. Some of the cases, although chloroform was assigned as the cause of death, seem simply deaths from the surgical procedure adopted. In the preceding lists several of the cases should have perhaps been also removed and placed under this heading, but the line is difficult to draw, and so when the narrators have positively stated the death to be the immediate result of the chloroform, it has been so classed by us. In a few cases—*e.g.*, Series B, 9—the anæsthetic seems to have had no casual relation with the death either directly or indirectly. It was, however, regarded as a death from chloroform by the reporter.

Series A.—1848-1864.

- 1.—Male, aged 16. Lithotomy. Lateral operation performed. There was difficulty in removing the stone. Patient never completely regained consciousness after the operation; during the night constantly delirious. Felt pain when abdomen was pressed 14 hours after the operation, and died at end of 28 hours. No post-mortem. Had suffered from symptoms of stone for 12 months, previously very healthy.
- 2.—Female, aged 28. Removal of small mammary tumour. "A very moderate quantity" of the anæsthetic was given. Patient was very sick and faint afterwards, requiring stimulants. During the night was very restless, notwithstanding the exhibition of morphia. At 5 A.M. on the following day violent vomiting of thin biliary matter again set in and continued for several hours. She became unconscious and died at 11 P.M., 56 hours after the operation. For several hours before her death her pulse was quite imperceptible. The wound had healed by first intention. No post-mortem. She was a slight nervous woman.
- 3.—Female, aged 52. For onychia of the left thumb; anæsthesia $\frac{1}{2}$ hour. Respiration and pulse failed together. The patient was long in yielding to the anæsthetic, requiring a "more than ordinary proportion of chloroform vapour to atmospheric air," passed suddenly from state of excitement to one of coma, which condition passed off in a minute or two and nothing unusual presented itself again, her pulse being rather better at the conclusion of the operation than at the commencement; rather less than $\frac{1}{2}$ gr. morphia was injected beneath the skin of arm—"she had taken about 1 gr. in three doses during the night." After operation complained merely of feeling sick, was left quite comfortable at 1.30 P.M. Until 3 P.M. she remained perfectly sensible when she seemed to drop off to sleep, but soon after began to breathe in a peculiar way. Her husband having examined her and finding her pulse, as he thought, good, was satisfied, as he was accustomed to hear her breathe in this way when asleep. At 3.45 P.M. she was seen by her medical attendant, who was told that she was "sleeping nicely," and found her comatose, cheeks deep purple, lips livid, face cold, conjunctiva insensible, pupils contracted, not affected by light; breathing stertorous, about 3 respirations in a minute, gurgling expiration. Pulse 90, regular, small, weak. Mustard poultices were applied to epigastrium and calves of legs; ammonia to nostrils and lips followed by an enema of turpentine and coffee; respirations then increased to 6 or 7 in a minute; the pulse, too, improved in volume and power, and face grew less livid and dusky; 12 leeches also applied to temples but slight improvement soon gave way, pulse becoming feebler, respiration slower, till she sank gradually and died at 6 P.M., about 5 hours after chloroform had been discontinued. Very stout and of plethoric habit. Extremely timid and nervous. Had been suffering from onychia of the left thumb for several weeks, but would not permit any incisions to be made; under a fresh attack of inflammation she was persuaded to take chloroform for the purpose of operation.
- 4.—Male, aged 64. Removal of tumour of eyelid; $\frac{1}{2}$ hour. Chloroform $1\frac{1}{2}$ oz. Anæsthetic only produced slight drowsiness. Patient remained well until 6.0 next morning, and suddenly

died about 18 $\frac{1}{2}$ hours after chloroform inhalation. Post-mortem 24 hours after death—all organs healthy. Coagulability of the blood slightly diminished. Healthy peasant.

Series B.—1864-1891.

- 1.—Aged 30. In labour for 7 $\frac{1}{2}$ hours, the chloroform given at intervals from a handkerchief, 3 $\frac{1}{2}$ oz. being used. Died 5 days after administration from excessive vomiting. No abdominal tenderness. The cause assigned for death was exhaustion. The patient is described as being violent during the labour.
- 2.—Male. A ligature of femoral above profunda was about to be applied for gunshot wound of the thigh. He vomited during the operation, and subsequently sank and shortly died from what was at the time thought to be exhaustion; but there is no doubt that the true cause of death was asphyxia, for the post-mortem showed that the trachea was filled with vomited matter.
- 3.—Boy. Amputation of leg. chloroform given by "usual method." Boy is said to have been apparently quietly asleep, when upon chloroformist touching his throat, he said "Don't put your hand upon my throat." He remained with eyes open during the operation but appeared ignorant of what was going on. "In this case clearly consciousness was retained and sensation was clearly lost." Retention of consciousness apparently regarded as "untoward" symptom.
- 4.—Male, adult. Removal of tumours of eyelids. During operation the chin dropped, and face became deathly pale. Ammonia and water poured into mouth was not swallowed. Artificial respiration commenced by mouth to mouth insufflation. Then more ammonia given. In $\frac{1}{2}$ minutes respiration and circulation re-established, and operation concluded. About 4 hours later the patient suffered from sore throat. Respiration very difficult and pulse rapid. Died 36 hours later. Congestion of lungs caused by dilute spirits of ammonia having entered the lungs. Post-mortem. Report not given.
- 5.—Male, aged 29. Circumcision. Operation successful under chloroform, but followed by excessive and continual vomiting, which proved fatal on the ensuing day.
- 6.—Female. Amputation of left breast for cancerous tumour. Respiration failed first. Complete anæsthesia was obtained, after which semi-consciousness was allowed. Operation was long and dressing difficult. After operation all went well first day; on second, oppression and cough; next day respiration and pulse rapid, skin hot, bronchitis had set in, but there was no trace of pleurisy or pneumonia. In spite of active treatment and the application of a large blister, erysipelas appeared round the wound on 7th day, and on same day serious vomiting, which was allayed. Death took place about 11th day, the bronchitis getting worse than ever. The last symptoms were severe pains in the knees and ankles, which proved to be purulent arthritis of the femoro-tibial and tibio-tarsal joints. Asphyxia caused by bronchitis. Post-mortem. Purulent arthritis of the femoro-tibial and tibio-tarsal joints, but no other purulent deposit. Not far from the bifurcation of the trachea, over against the large bronchial tube of the right side was found an oblong tumour nearly as large as a chestnut, resulting from the calcification of an enormous bronchial ganglion. This had pressed on the pneumo-gastric nerve and had irritated it. Lungs red, in some places almost blackish-red, especially toward base of right lung, where there was a large area of ecchymosis. No hepatisation, pieces of lung floated in water. Pulmonary tissue softened however; bronchial tubes reddened and much irritated. Heart fatty, no valvular lesion. Kidneys congested; spots of ecchymosis as in lungs. Was exceedingly fat. Before anæsthetisation there had been a repeated and most careful auscultation which revealed nothing abnormal in either heart or lungs.
- 7.—Female. Removal of tumour from breast. Respiration failed first. There were no untoward symptoms at first after the operation, when bronchitis supervened with laboured breathing growing worse and worse. Death took place at end of 8 or 10 days. Asphyxia was the only apparent cause. No post-mortem allowed. The patient was very fat. There had been a most careful auscultation before giving the chloroform.

- 8.—Male. To facilitate reduction of hernia of long standing. Respiration failed first. From the time of operation there was oppression in breathing, præcordial trouble, vomiting, and diarrhoea. On 4th day after operation respiration was 40 per minute, and pulse small and rapid (130 per minute). In spite of treatment patient became worse, and died on 17th day. Cause assigned for death—*asphyxia*. Post-mortem—no local cause for death. Auscultation had revealed some crepitant râles toward the apex of the lungs, otherwise the sounds heard had been normal.
- 9.—Dilatation of anal fissure. Respiration failed first. The anaesthetisation showed nothing uncommon; $\frac{1}{2}$ hour after the patient said he felt comfortable, but respiration became uneasy, hissing and sonorous râles were heard on auscultation of both lungs; no dullness on percussion. Up to 7th day the symptoms grew worse, respiration 54 per minute, pulse 140. The crepitant râles were mixed with sonorous râles. On 8th day there was a sort of lull, this was at once succeeded by diphtheria, which rapidly extended over the buccal and pharyngeal mucous membrane. The patient died, suffocated, 10 days after the operation. *Asphyxia*. Very fat, strong and full blooded.
- 10.—Female, aged 41. Craniotomy in a case of contracted pelvis. Respiration failed first. Operation performed and patient delivered with the greatest difficulty. Was under chloroform 8 hours. Reacted fairly and felt well but feeble; 36 hours later developed intense dyspnoea. Was cyanosed and found suffering from general pulmonary hyperæmia. All larger and smaller bronchi full of mucus, which was expectorated with great difficulty. Patient died 8 hours later. Dyspnoea caused probably by decomposition of chloroform.
- 11.—Male. For compound fracture of thigh. "Small quantity" of chloroform given. Patient died suddenly during anaesthesia. No food or mucus found in mouth: tongue had been drawn well forward. Artificial respiration and electricity employed when first dangerous symptoms appeared. The patient died from asphyxia. At the post-mortem a piece of chewed tobacco found in the larynx completely obstructing glottis. Chloroform pure.
- 12.—Male. For fracture of neck of femur: 3 dr. of chloroform used on Esmarch's mask. Pulse and respiration failed together. Patient suddenly ceased to breathe, and directly after the heart failed. Every means resorted to to resuscitate the patient; artificial respiration for $1\frac{1}{2}$ hours, tracheotomy, electricity, strychnine injections without avail. The cause assigned for death was fatty embolism, as shown by post-mortem, which showed vessels of lungs, especially capillaries, full of minute particles of fluid fat. Patient of strong healthy constitution, but intemperate.
- 13.—Removal of sequestra of bone from region of shoulder. Operation lasted 1 hour: no incidents of note occurred; patient without doubt recovered from anaesthesia. Was put to bed; died suddenly $\frac{1}{2}$ hour afterwards. Post-mortem. No lesions capable of accounting for the fatal termination. The recorder of this case, of which no explanation could be given, proposed to style it "death following chloroform," but not "death by chloroform."

"UNTOWARD" CASES OF CHLOROFORM ADMINISTRATION.

WE have now to submit probably the most important part of our Report—those recorded cases of chloroform inhalation in which more or less grave symptoms occurred eventually disappearing on resuscitative measures being adopted. It seems more likely that lessons of material importance will be learnt from the study of such cases than from that of fatalities; for in the latter instance facts are often overlooked in the stress of the moment, while in the former there is usually less haste, more precaution, and a more orderly carrying out of such manœuvres as the character of the symptoms suggests. We are likely to learn from these cases somewhat of the nature of chloroform toxæmia, the procession of its symptoms, and the result of measures adopted for remedying its dangers. We are able to present a comparatively large number of instances of untoward cases—245—although these cases in which dangerous symptoms arise during Chloroform Narcosis are seldom published, the heading "Fatality under Chloroform" being unfortunately far more common.

CLASSIFICATION OF CASES.

Of the 245 cases reported, 101 are stated to have occurred in hospitals and 90 in private practice; and in several of the reports sent to THE LANCET in response to the Special Inquiry forms numerous cases are grouped together without any particular number being specified.

AGE AND SEX AS DETERMINING FACTORS.

The same conditions appear to obtain in the cases now under consideration as were mentioned and discussed under the heading of Fatalities on p. 90 of this report.

GEOGRAPHICAL DISTRIBUTION.

As was stated above (p. 90) no telluric or climatic influence could be proved to affect the area of distribution of fatalities under chloroform, so also the same holds true for the "untoward cases." Records of these cases from even a larger area than that given at p. 90 have reached us. It might be thought that more recoveries would occur in certain latitudes—i.e. in regions in which persons were more favourably placed as regards chloroform and so would stand a better chance of eliminating an overdose, but the facts before us do not justify any such conclusions. The fact is very important

that fatalities and untoward cases appear to be distributed over corresponding areas, so it would seem to indicate that climate and race are not important factors in determining them. If, for example, deaths were very rare in our latitude but untoward cases were fairly frequent it would show that although the inhabitants were liable to casualties from chloroform yet they were so far helped by their physique or by climatic influences as to get rid of the chloroform before a fatal issue showed itself. This, however, does not appear to be the case.

METHODS OF ADMINISTRATION.

Untoward symptoms seem to have occurred both when chloroform was administered according to the open method as well as when an inhaler was employed. The variety of inhalers seemed to point to the conclusion that none were absolutely to be relied upon as a certain preventive to grave symptoms of toxæmia.

PREDISPOSING CAUSES.

In only a very few instances do we find any particulars noted of conditions which might be held as predisposing to the production of untoward symptoms under chloroform. Thus, intemperance, epilepsy, cancer, although noticed as having been present two or three times, may practically be regarded as having been omitted from the consideration of those who reported the cases. In one instance an individual is mentioned as having on two separate occasions given evidence of chloroform toxæmia from which recovery took place. The occurrence of complications during the operation, such as vomiting or profuse hæmorrhage, do not appear to have been responsible, save in a very few cases, for the onset of grave symptoms.

DIRECT CAUSES.

The immediate causes of danger in these cases are practically in every case respiratory or circulatory. We are told that in a very large proportion of cases the respiration failed before the heart or pulse showed signs of flagging, and it will be seen that the measures adopted in resuscitation were in most cases those which are applicable to cases rather of cessation of respiration than to those of cardiac failure.

THE MEASURES ADOPTED FOR RESUSCITATION.

The measures adopted for resuscitation consisted in the admission of air by throwing open windows and doors. In one case the patient was held by his legs outside a window.

Artificial respiration is mentioned as having been employed in more than half of the untoward cases, and to have been successful in the majority of the instances when resort was had to it. The following plans of conducting artificial respiration are mentioned:—Mouth-to-mouth insufflation, with or without compression of abdomen or thorax; lateral compression of thorax. The other methods mentioned were: Howard's, Marshall Hall's, Silvester's, the performance of laryngotomy with or without the insertion of a tube, or tracheotomy and artificial respiration. Various other adjuvant measures were tried during the artificial respiration. The use of both faradism and galvanism is mentioned as successfully employed in a few cases. The object in most of the instances was to excite the diaphragm to contraction either by direct stimulation or through the phrenic nerves. The substitution of ether given by inhalation was successfully adopted in a few cases. Nélaton's method of inversion was frequently employed in the later cases, and a considerable success is claimed for this plan. No mention is made of any dangerous symptoms having followed its employment. It appears to have been resorted to mainly in cases when more or less enfeeblement of the circulation occurred, and when this was associated with failure of respiration inversion was practised, together with the performance of artificial respiration by compression of the abdomen and thorax. In one case we are told that, besides inversion, the patient's trunk was swung laterally so as to resemble the oscillations of a pendulum, although what was the particular merit of this movement does not appear to be very clear.

Mechanical stimulation of the larynx by pressing a finger down to the glottis was stated to have been successful in one case. This procedure is interesting in connexion with the views of certain authorities that mechanical traction upon the tongue or grasping the epiglottis and dragging it forward, either by means of a thread introduced into it or by means of fine vulsellum forceps, will successfully initiate natural breathing even after some seconds' cessation of respiration. Very various forms of stimulation are credited with success in the treatment of the dangers of chloroform toxæmia—e.g., the mechanical mode of applying cold or heat to the thorax or præcordium by simple application or by being dropped upon the body from a height; in one case the water is described as having been "nearly scalding," in others the feet were immersed in "almost scalding water"; slapping with a wet towel and friction to the præcordium, chest wall, and spine, with or without stimulating applications like turpentine; tickling the soles of the feet, massage of the rib-muscles and twisting of the arm are also mentioned as remedial measures. Hypodermic injections of ether or brandy are reported in some cases. Internally the usual stimulants—sal volatile, brandy, and so on—have been given by the mouth; nitrite of amyl inhalations, rectal injections of hot coffee, brandy, and hot water are all mentioned. Valerian is stated to have been given with success in cases in which, although the respiration was restored, it yet remained feeble. Venesection was practised in one case.

NATURE OF OPERATION.

The character of the operations in progress when untoward symptoms arose cannot be of slight importance, as it will be seen by a study of the cases that in not a few "shock" is assigned as the cause of the untoward symptoms.

The following list comprises the operations named: Opera-

tions on the abdomen; for the relief of large strangulated hernia; and for ruptured gall-bladder; amputation of the thigh; operations on bone; on the breast (serious); on the chest (emphysema, pneumotomy); reduction of dislocations; reduction of fractures; amputation of penis; operations on the eyes; catheterisation; circumcision; cystotomy; lithotomy; for phimosis; for elephantiasis of scrotum; sounding of bladder; dilatation of the cervix; uterine polypectomy; removal of uterine fibroid; serious cases of operations on or about the jaws; incision of joints for pyoarthron; ligature of the external iliac artery; forcible movement of joints; removal of nævus; removal of glands from the neck; operation on nerves; obstetric cases; operation for hæmorrhoids, for fistula in ano; stretching of sphincter ani; extraction of teeth; removal of tongue; tracheotomy; and removal of tumours. In many cases the operation had not been commenced when the disquieting symptoms appeared.

We now pass to the abstracts of the actual cases.

Series A.—1848-1864.

- 1.—Male, young. Amputation of thigh. Pulse and respiration failed together. Pulse and respiration suddenly stopped, countenance altered, and jaw dropped. Marshall Hall's "ready method" of artificial respiration was persevered with for half an hour before there was any evidence of return of life; but at end of 45 minutes the patient spoke. In this case the chloroform was said to be "very impure."
- 2.—Male. To examine the bladder and prostate gland. Pulse failed first. In 3 or 4 minutes the breathing was much accelerated, and the chloroform was discontinued. The pulse ceased, and subsequently the respiration. The heart sounds could not be heard. The Marshall Hall's "ready method" of artificial respiration in two minutes caused signs of returning animation.
- 3.—Female, aged 45. Removal of tumour from breast. Pulse failed first. More chloroform was being given to prevent returning sensibility, when the pulse became weaker and ceased; bleeding from the wound stopped, and respiration was suspended, the heart's action very imperfect. The face became livid, then colourless, and the pupils dilated. Artificial respiration (*bouche à bouche*); in 3 minutes radial pulsation was felt to return, and in 6 or 7 minutes complete recovery had taken place. Full anæsthesia had been obtained, and the operation was nearly completed when untoward symptoms set in.
- 4.—Female, aged 18. To relieve neuralgia of eyeball. Chloroform by Snow's inhaler. Respiration failed first. In 1 to 1½ minutes from the commencement of inhalation the patient moaned, and respiration ceased; pulse continued steady; shaking and cold affusion instantly employed. Pulse commenced to fail. Artificial respiration by compression of thorax was practised, then the Marshall Hall's "ready method," which induced inspiratory efforts; but it had to be persevered with for 3 hours. The reporter of the case regarded it as an instance of "secondary apnoea," due to a prolonged administration of chloroform 10 hours before. The patient had frequently taken chloroform for the same affection, even 2 or 3 times a day.
- 5.—Female, aged 6. Excision of knee-joint. Pulse and respiration probably failed together. Insensibility passing away, more chloroform was given. Pulse became feeble, and in a minute ceased to beat; the respiration also stopped. The tongue was drawn forward, and artificial respiration by compression of the thorax was tried, but for 15 minutes no pulse or positive sign of life was evident. An enema with brandy given. The pulse then became perceptible, but very faint and flickering; in 10 minutes it improved a little, and then gasping took place. Ammonia applied to the nostrils caused a scream and a sudden inspiration. Artificial respiration was kept up for more than ½ hour. Anæsthesia had been complete. Had taken chloroform to insensibility three times before.
- 6.—Male, aged 4. Removal of tumour from eyelid. 1 drachm of chloroform given on a sponge. Pulse failed first. In less than 2 minutes the pulse became feeble; inspiration short, tracheal rattling; face livid, limbs relaxed. Cold affusion and ammonia to nostrils were applied; mucus wiped from epiglottis with a sponge; friction applied to thorax. These tried for 2 or 3 minutes, when pulse ceased; pupils dilated; jaw dropped. Compressions of abdomen used for 3 minutes, when one conductor of Du Bois Reymond's induction apparatus was placed on the course of the phrenic nerve, the other on the seventh intercostal space, and alternated from side to side. This produced a sob, and on discontinuing the process there was a spontaneous inspiration; the pulse also returned. Compression of abdomen was again resorted to, and continued for about 20 minutes, when recovery was complete. Any cessation of the compressions caused enfeebled pulse and respiratory efforts. Operation not commenced.
- 7.—Female, aged 50. Removal of breast for cancerous disease. Chloroform given in an inhaler. Insensibility not complete. Operation not commenced. Pulse and respiration failed together. In 5 minutes the conjunctiva was still sensitive, and pupil contracted; slight cough occasionally. A profuse perspiration broke out, the pulse failed, and, with the respiration, ceased. The pupils were "contracted to a pin's point"; face pale, lifeless. Cold affusion and compression of chest resorted to, when in about a minute the respiration could be felt fluttering, and soon began to improve. A gasp was given and

- pulse rose at once, becoming regular, but weak. The operation was then performed, followed by faintness and vomiting.
- 8.—Male, aged 54. To pass a catheter in case of stricture. Pulse and respiration failed together. The respiration became rapid, the eyes suddenly assumed a "corpse-like appearance." Pulse and respiration ceased. The tongue was drawn forward. Artificial respiration by compression of the thorax and cold water affusion induced several vigorous inspirations and the pulse returned. The alarming symptoms lasted for three minutes. The patient was nearly under influence of chloroform, but the operation was not commenced at the time of the onset of the bad symptoms.
- 9.—Male, young. To sound for calculus in bladder. Pulse and respiration probably failed together. Did not take chloroform readily. He breathed with stertor for a few seconds, and then respiration ceased. Tongue was pulled forward by means of a hook, and air was heard to rush into the now-open glottis. Compressions of the abdomen resorted to and heart's action recovered. He was not fully under the influence of chloroform when untoward symptoms supervened.
- 10.—Female, aged 9. Removal of necrosed bone from femur. Pulse and respiration apparently failed together. In 35 minutes the face grew pale; pulse was small, feeble, and fluttering; respiration slow and indistinct; the surface of body cold, with relaxation of the sphincters. She was fully under influence of chloroform, and the operation had been commenced. The means of resuscitation adopted were: Exposure to cold current of air, warmth by heated flannels, administration of brandy and diluted liquor ammonia. She gradually but slowly recovered.
- 11.—Male, aged 64. Excision of a cancerous tumour from the axilla. Duration 10 minutes. Complete anaesthesia. Operation commenced. Pulse and respiration failed together. Had inhaled for 10 minutes, when respiration grew stertorous, face congested, pupils rather dilated, pulse labouring and slow. These symptoms became more marked, and respiration seemed on the point of ceasing. Means of resuscitation: exposed to a current of air, and cold affusion employed. Gradually the danger passed away, but he continued quite insensible until operation was completed.
- 12.—Female, child. To examine a diseased elbow-joint. 2 drachms of chloroform given from an inhaler. Pulse and respiration failed together. After being insensible for about 5 minutes pulse became quick, then slow, and afterwards imperceptible; the respiration also ceased. Anaesthesia was complete in 6 minutes. Tongue drawn forward; compressions of thorax resorted to; face became intensely livid. In 2 or 3 minutes spontaneous inspiratory efforts. Recovered in about 10 minutes. Had taken chloroform previously two months before.
- 13.—Female, aged 30. To relieve neuralgia of face. 2 or 3 drachms of chloroform given on a napkin. Pulse and respiration failed together. Face changed to a pallid hue; eyes dull and glazed; jaw dropped, and respiration and pulse ceased. Heart sounds inaudible. Had been under influence 20 minutes. Exposed to current of cold air. Tongue drawn forward, and in doing so a set of artificial teeth were found loose in the fauces, and removed. Artificial respiration by compressing thorax. In 10 minutes there was a spontaneous effort at inspiration, and in 10 minutes more patient had quite recovered.
- 14.—Female, aged 45. Removal of mamma for scirrhus; 1 minute. Probably pulse failed first. She was in a sitting posture. After having inhaled for 1 minute, the chloroform maintained a "strong influence" from 2 P.M. to 4 A.M. 14 hours after operation she suffered from syncope, the pulse being very irregular. She eventually recovered. Operation completed.
- 15.—Male. Strangulated hernia. About 2 drs., in three doses, of chloroform given, on piece of lint in a handkerchief. Pulse and respiration failed together. About 40 minims were first given, with no effect beyond a slight spasm of the limbs, and a rise of rate of pulse from 70 to 90. Thirty drops were added, but he still remained conscious at the end of 3 or 4 minutes, when 40 minims were again added. In about $\frac{1}{2}$ minute the spasm relaxed. Pupils dilated; pulse 80, steady, full; slight stertor, and the chloroform was removed. The respiration became noiseless, slight, and in 20 seconds altogether ceased. The pulse intermitting. Under influence of chloroform; operation not commenced. Cold water and wet towel produced no effect, and the pulse ceased. Mouth-to-mouth insufflation, with pressure on the chest, produced a slight respiratory effort, after about 20 insufflations, and the pulse could be felt as a thread after 7 or 8. Vomiting occurred and respiration failed, but was restored by the same means, the pulse being weak, but steady. Soon vomiting again set in, and the breathing gave way, but was re-induced by artificial respiration as above. Consciousness returned after a short time. He remained very drowsy, but was not allowed to sleep, as when he dozed the respiration became diminished, and the pulse faltered. He gradually recovered.
- 16.—Female, aged 39. Removal of breast for scirrhus. About 3 dr., in 2-dr. and 1-dr. doses, of chloroform given from Snow's inhaler. Pulse and respiration failed together. After 5 minutes' inhalation she vomited some mucus, and the chloroform was temporarily discontinued, but at the end of 15 minutes from its commencement she was completely under its influence; with muscles relaxed, pulse 80 (it had risen to 144), breathing easy, with slight stertor, chloroform discontinued, and operation commenced. After 4 minutes, sensibility was returning, and inhaler applied with another drachm of chloroform; this soon produced its effect, and was again removed. The respiration now became more and more feeble, so as to be scarcely perceptible in 3 or 4 minutes, and pulse irregular. Perfect anaesthesia. The face became livid, and cold-water douche applied; the pulse and respiration improved slightly, but they shortly again failed, and there was an effort at vomiting. At this time (50 minutes from commencing to inhale) the face was livid, hardly any respiration, and the pulse scarcely to be felt; the tongue was not retracted. Cold douche applied, and ammonia to the nostrils. In about a minute galvanism was employed; a few applications caused a deep inspiration, and in a few minutes breathing was fully restored. Galvanism was continued for a short time, and consciousness returned. She had no relapse, and recovered without a bad symptom.

Series B.—1864-1891.

- 1.—Male. Reduction of dislocated femur. Chloroform given on handkerchief. Pulse and respiration failed together. In 5 minutes stertorous breathing set in; respiration became slow and laboured; pulse flagged, and skin became livid. Operation performed, but patient became almost asphyxiated. Measures for resuscitation adopted: slapping on chest and buttocks, cold water poured from a height on chest. In 3 or 4 minutes patient gave deep inspiration; air was expelled by gentle pressure of chest; this was repeated several times, and cold affusion continued, until in $\frac{1}{2}$ hour recovery took place. Reduction of dislocation accomplished.
- 2.—Numerous cases. Resuscitation by vigorously slapping with flat hand naked surface of body and limbs, and by flapping face and front of chest with corner of wet towel; this produced deep inspiration, and action of heart was restored even when pulse had ceased. Continued till breathing, pulse, and colour were natural.
- 3.—Female, aged 23. Amputation for obscure disease of knee-joint (2 or 3 minutes). 6 dr. chloroform (on lint folded in funnel shape). Pulse and respiration failed together. Inhaled chloroform quietly. In 2 or 3 minutes was insensible, with slow, steady pulse, and natural respiration. Pulse became slower. When operation about to be commenced respiration ceased suddenly, and pulse could not be felt. Cold water thrown on face, artificial respiration practised, and air freely admitted into room. As last resource, trachea opened, and lungs inflated through wound. This failing, catheter introduced, and artificial respiration kept up through it. Patient spare, not emaciated. Pulse rather feeble, heart sounds normal. After recovering from chloroform, disease became worse. Chloroform again given successfully, and limb removed; but disease returned, and she died about 6 weeks later of hæmorrhage.
- 4.—Male, aged 58. Removal of tumour in right mastoid region. Chloroform 1 dr. 45 m. Respiration failed first. He had scarcely taken $1\frac{1}{2}$ dr. when face became red and respiration difficult; 2 minutes after cessation of respiration the pulse ceased also, the face became pale, lower jaw fell, and eyes remained open, with dilated pupils. The chloroform was immediately withdrawn. Cold-water frictions and ammonia applied, and respiration was sustained by pressing up the diaphragm. Pulse regular and not weak, but respiration became more laboured, and finally ceased. The mouth was opened with difficulty, and a silver tube passed into the larynx for the purpose of inflating the lungs, but only slight distension of thorax ensued, the air escaping at the side. As this did not do tracheotomy was performed, and a large tube introduced as far as the bifurcation of the trachea, and air was forced in and out. At the end of 6 or 8 such inspirations, the pulse returned gradually, respiration became re-established, and the wound began to bleed. In $1\frac{1}{2}$ hours patient coughed up a quantity of bloody mucus from trachea. Strong coffee was introduced into stomach, and an enema of msh given. Cold douche to head, and blister to epigastrium. Patient slept well, and was all right next day.
- 5.—Male, aged 14. Removal of sequestrum from tibia. Pulse failed first. In the middle of the operation the patient began to struggle; this was followed by stertor, cessation of heart's action, and of respiration, the lips were blanched and the limbs flaccid. Artificial respiration (Silvester's method), smacking face and chest with wet towel. Faint gasping in 2 or 3 minutes; galvanism to nape of neck and epigastrium restored heart's action. Recovery. Brandy and water given. The patient was very timid.
- 6.—Female. Respiration failed first. Respiration ceased, and patient seemed almost dead. The heart continued to beat however. Forced respiration kept up for a time, and cold water dashed on chest and face.
- 7.—Male. Trivial. Fainted under use of chloroform. Resuscitated by simple measures.

- 6.—Male 32. Removal of bulbous nerve from stump of lower third of arm after amputation. Pulse (probably) failed first. When operation was begun patient turned pale, breathing ceased, and pulse also ceased. Cold water dashed on face and chest, without avail, artificial respiration by compressing chest laterally; lower jaw forced downwards and mouth kept open. Tongue held out of mouth by means of flat forceps. Respiration and pulse slowly returned, and in 3 or 4 minutes fully established. Operation proceeded with and completed.
- 9.—Male, aged 4. Amputation of arm. Small amount of chloroform used. Boy was weak and faint on admission, was given stimulants and opiate. Remained under influence of chloroform for considerable time, 10 minutes after apparent recovery became restless, jerking arms about, symptoms were put down to congestion of the brain from chloroform. Pulse slow, full bounding. Action of heart and lungs normal. Convulsions. Final recovery. The recovery from chloroform is stated to have been perfect before the onset of these symptoms.
- 10.—Female, aged 25. Removal of "fungus hamatodes" from arm. Towards close of operation face became livid, breathing stertorous. In $\frac{1}{2}$ minute, patient was apparently at point of death. Ammonia and brandy given, patient slowly recovered.
- 11.—Male. For elephantiasis scroti. Small quantity chloroform used. Pulse failed first. As he was "coming under" the chloroform, pulse suddenly failed, neither lividity of face nor failure of respiration occurred at first. "Usual restoratives." Apparently healthy man.
- 12.—, aged 4. Removal of encysted tumour from eyelid. Chloroform on sponge and compress (4 grm.). Pulse and respiration together. Pulse became small almost immediately; inspiration laboured, face livid, respiration gradually ceasing; pulse totally ceased in 3 minutes. Artificial respiration; ammonia to nostrils; faradic current to phrenic nerve, and 7th intercostal space, compression of abdomen also being employed. Operation proceeded with and patient did very well. Recovered ultimately.
- 13.—Female. Amputation of breast. Pulse and respiration together. Respiration reduced to 5 or 6 per minute, radial pulse scarcely perceptible; these symptoms attributable to want of care on part of administrator, who wanted to witness operation. Restored by giving brandy.
- 14.—Male, aged 18. Removal of strumous cervical glands. Snow's Inhaler used. Pulse and respiration together. Struggling; heart's action and breathing ceased. Severe flagellation on every part of body for 10 minutes; mouth opened, tongue drawn forward. The patient was strumous.
- 15.—Female. Removal of polypus of uterus. Shortly after the administration of the chloroform, and before complete anaesthesia was induced, her pulse began to falter, her breathing was embarrassed, and her countenance livid. Ether was substituted for chloroform with the best results. Patient was very anæmic, and feeble from loss of blood. She had a damaged heart, and profuse sanious discharge from vagina.
- 16.—Female. Removal of scirrhus breast. Immediately the tumour was removed pulse and respiration were noticed to have ceased. Artificial respiration at first tried with no effect, and then the rotatory electrical apparatus was administered, one pole at nape of neck, and the other at epigastrium. Gradually respiration returned, and operation was completed, the patient being still under chloroform.
- 17.—Male, aged 54. For ligature of pile. $1\frac{1}{2}$ oz. of chloroform. Pulse and respiration failed together. Operation begun, but as patient flinched more chloroform given. Respiration ceased, and no pulse could be felt at wrist. Measures adopted for resuscitation were placing on back; pulling forward tongue; artificial respiration (Silvester's method); cold douche; ammonia. These failing galvanic battery applied—one pole to cardiac region; other to nape of neck—for 2 minutes. Beat felt at wrist; breathed again, soon respiration and appearance natural. On examination after recovery, no disease of heart and lungs could be detected. Slight aëres senilis. "The action of the heart recovered by stimulus other than respiration."
- 18.—Male, aged 72. Reduction of dislocation of right humerus into axilla. 30 min. of chloroform on lint. Pulse and respiration failed together. After fourth inspiration, respiration ceased, pulse stopped, eyes became glazed, pupils dilated and insensible to light, iris could be altered in shape by pressure on eye-ball, there was also dropping of jaw. It was evident that anæsthetic vapour had produced temporary arrest in circulation through pulmonary capillaries, and the mixed air had failed to stimulate the filaments of the pneumo-gastric. Chloroform at once suspended; and resuscitation commenced, as follows: Left hand laid firmly across chest. Right hand crossed over left, and forcible pressure made; hands then suddenly removed, and chest allowed to expand by its own elasticity. These movements repeated three times in $\frac{1}{2}$ minute with no effect. Liquor ammonia fortioris on sponge held close to nostrils during each interval of compression so that the ammoniacal vapour was inspired during each expansive movement of the chest. After 6 artificial respirations, patient gave a gasp, and after 12, a second and third gasp. In 8 minutes more pulse felt at wrist, and in 35 minutes complete restoration. Shoulder dislocation reduced while in lethargic stage. Was of healthy constitution.
- 19.—Male, aged 12. Amputation of right forefinger. 3 dr. of chloroform. Respiration failed first. Directly anæsthetic had been given, patient suddenly ceased breathing, face and upper extremities becoming livid; pupils dilated, eyes glazed, conjunctivæ suffused, and pulse at wrists and carotids absent. Same treatment as in above case adopted; after 10 minutes became conscious, and in 20 minutes breathing and circulation became quite normal. Healthy. Cause of untoward symptoms "no doubt first non-oxygenated blood passing through lungs, and then temporary arrest in pulmonary capillary circulation."
- 20.—Male, aged 8. Removal of large fibrous tumour from back of left thigh. About 1 dr. of chloroform used. For anæsthesia, patient was placed upon face, owing to situation of tumour. When operation was completed, he became pallid and cyanosed with cessation of respiration and pulse and heart's action. Same treatment as in two preceding cases resorted to, and in 15 minutes pulse and respiration returned. In another 5 minutes there was a relapse. Cold affusion and galvanism employed with no effect; ammonia then applied to nostrils, and chest compressed 8 times in minute; after 12 minutes patient began to breathe naturally and to recover consciousness. For several days very ill with wandering delirium, nausea, and vomiting, but ultimately made good recovery. Delicate, but presenting no evidence of internal disease. In this case, probably, too little atmospheric air mixed with chloroform, and from position of patient, jugular veins may have been accidentally compressed; hence, independently of quantity of vapour inspired, there was probable disturbance in cerebral circulation and temporary effusion (serous).
- 21.—Pulse said to have failed first. Patient's hands cold and wet, features pinched, muscles of face relaxed, lids half-open, and corneæ turned upwards. Tongue withdrawn and patient placed at inclined plane of 40 deg.; this restored pulse and breathing in 15 seconds. On restoring patient to horizontal position, bad symptoms returned, but change in position followed by relief.
- 22.—Male, aged 30. Removal of tumour from front of leg. Pulse and respiration failed together. Sudden lividity, changing to deepening purple; respiration and pulse ceasing. Artificial respiration (Silvester's method) and flipping with wet towel gradually restored animation.
- 23.—Removal of small tumour—incision of carbuncle. Sudden fainting, with pallor of face, open eyes, and very dilated pupils. Artificial respiration restored animation.
- 24-25.—No particulars given.
- 26-32.—Pulse and respiration failed together. Immediate action of faradisation current successful.
- 33-34.—Indications of imminent danger. Promptly turning over in semi-prone position, pulling out tongue, and dashing cold water on chest and face were the measures adopted for resuscitation.
- 35.—Male, aged 19. Re-amputation of leg above knee. Skinner's inhaler used. Respiration failed first. Profuse vomiting set in when chloroform was beginning to take effect. After re-application, and in middle of amputation, patient stopped breathing. Placing in semi-prone position; tongue pulled out with artery-forceps; artificial respiration (Silvester's method) commenced; windows thrown open; cold affusions. As patient remained pulseless and livid for 10 minutes, battery applied to neck and diaphragm continuously. This not succeeding, pole at neck alternately applied and withdrawn; gasping occurred, which changed to normal breathing. Returned to life in 20 minutes from first cessation of respiration.
- 36.—Female, aged 50. Removal of breast for cancer. Pulse and respiration were believed to have failed simultaneously. While securing arteries, circulation suddenly stopped. No pulse, no respiration; no colour, but ghastly white. Laying on floor, head lower than body. Lips became red; in time, respiration returned. Recovery. No artificial respiration, and tongue not drawn out.
- 37.—Female, young adult. Amputation of leg. When dressing leg, breathing suddenly ceased. Breathless, pulseless, and pallid. Pillow and block, on which patient's head was raised for operation, struck away; head fell with noise on table. Lips reddened, face blushed, patient breathed and recovered.
- 38.—Female, young adult. Extraction of tooth. Pallor followed with usual signs of death. Was laid down, head lowered; lips presently showed signs of life, was saved.
- 39.—Male, aged 56. Amputation of thigh. Circulation ceased whilst wound was being dressed. Head hung down over table, and patient soon recovered. Delicate, and worn by long suffering.
- 40.—Infant. Removal of nœvus. Became alarmingly pale and apparently died. Artificial respiration and drawing out tongue tried, but much time lost. Child hung almost upside down, till lips grew red and recovery certain.¹
- 41.—Reduction of compound fracture of fore-arm. Respiration failed first. Arrest of respiration took place. Twisting the arm, which instantly caused an effort of inspiration to be made.
- 42.—Male, aged 60. Lithotomy. Respiration failed first. At beginning of operation, patient's respiration ceased, but pulse was

¹ This and the four previous cases were related to show the superiority of inversion over artificial respiration (Brit. Med. Jour., pp. 93, 94).

still going. Patient turned on his face and artificial respiration (Marshall Hall's method practised). Natural respiration not restored till tongue seized and drawn forwards by artery forceps. On turning patient, and allowing body to fall forward, a distinct expiration was audible, and though not thoroughly roused till tongue was seized, this would have been unavailing had not the artificial respiration allowed the effects of chloroform to pass off.

- 43.—Male, aged 10. Removal of cyst in right scapular region. Pulse and respiration failed together. While operation going on, patient ceased to breathe and pulse could not be felt. Cold affusion failed to produce respiration, and patient was slightly livid, when he passed off into pallor. Window opened, and 1 or 2 artificial elevations of ribs produced, without any improvement. Larynx felt to be open. Poles of electro-magnetic battery applied to sides of neck, producing slight spasmodic movement of muscles of neck and upper part of chest. This was repeated, and slight respiration and heart's movements took place. Battery made use of as stimulant and general irritant. Warm fomentations applied to chest, and pulse became better; respiration became deeper, and child began to cry, when hurt, in 3 hour.
- 44.—Female, aged 42. Removal of axillary glands. Pulse and respiration failed together. Respiratory movements ceased without previous stertor or other warning; face assumed death-like pallor with slight lividity, eyes staring and pupils widely dilated, and pulse immediately became imperceptible. This and the preceding are classed under "asphyxia" by the narrators. Tongue at once drawn out, which did not restore respiration. Poles of electro-magnetic battery applied to root of neck over phrenic nerve (cold affusions and compression failing meantime to restore respiration). At last, short gasp, then others deeper and regular; pulse became perceptible, colour returned to face, and pupils contracted.
- 45.—Male. For stone. Pulse failed first. Pulseless, deadly pale, and breathing stopped. Pulse ceased beating some time after chloroform discontinued. Galvanic battery. Both pulse and breathing returned.
- 46.—Male (elderly). Pulse failed first. Pulse stopped suddenly and patient seemed dead. Galvanic apparatus. Deep and rapid inspiration followed by strong noisy respiration. Patient then started into sitting posture. Circulation restored. Recovery.
- 47.—Female (elderly). Opening trachea for disease of larynx ($\frac{1}{2}$ hour). Pulse failed first. Pulse suddenly stopped. Galvanism, circulation and respiration restored.
- 48.—Boy. Pulse failed first. Pulse became imperceptible but did not stop entirely. Galvanism. Instant recovery.
- 49.—Girl. Amputation of leg. Pulse failed first, stopping suddenly. Galvanism. Instant restoration. Patient was given $\frac{1}{2}$ tumblerful of brandy next day and leg taken off without her being aware of it.
- 50.—Boy. Pulse failed first. Cessation of pulse first symptom of alarm. Artificial restoration and brandy enemata restored animation in about 5 minutes.
- 51.—Female (elderly). Removal of breast for cancer. Pulse and respiration failed together. Suddenly ceased to breathe and became quite pulseless. Measures for resuscitation. Battery. Patient gasped and breathed again. Her state one of almost excessive and fatal faintness; use of battery very marked; operation lastly completed; patient did well. Very courageous and energetic. Died suddenly 3 or 4 years later, as supposed, from cancer of lung.
- 52.—Female, aged 40. For mammary tumour. Suddenly became faint and collapsed and appeared dying. Was quickly revived. Was so weak that operation was postponed to another day and done without chloroform. About 3 months later, when patient had become very florid and stout, she died suddenly of apoplexy. Had cancerous growths in cerebrum, cerebellum, liver, and lungs.
- 53.—Male, aged 74. Reduction of large strangulated scrotal hernia. Pulse failed first. Pulse ceased, and all respiratory movements ceased at same time. Fell into a state of death-like syncope. Battery applied to epigastrium and back of neck, and patient struggled into life and started to sit up. Operation performed without chloroform. Died 3 days later of sloughing of the scrotum and integuments around.
- 54.—Male, aged 10. Extraction of small bullet from ear. Became quickly insensible; operation commenced, but had to be stopped as patient was restless and vomited. Respiration then stopped and he became blue and moribund. Turning over; tearing open clothes and smacking with wet towel; dripping with cold water over chest. At length gave a gasp, then another; began to breathe and gradually came to life. Food had been given to patient shortly before operation.
- 55.—Female (young). Excision of knee. Apparent death occurred; pallor, absence of pulse. Artificial respiration for 10 minutes before animation restored. Irritation of surface and brandy enemata also employed.
- 56.—Apparent death occurred; pallor; absence of pulse.
- 57.—Male, aged 35. Removal of two internal hæmorrhoidal tumours. Chloroform given on lint. Pulse and respiration failed together. After operation patient talked and laughed. This ceased and suddenly pulse and breathing stopped. Slapping face and chest; a slight movement seemed to follow, but deathly pallor increased. Sylvester's method practised without success, till a finger thrust down throat on top of glottis. Then patient slightly quivered, and by persistence in artificial respiration with redoubled efforts, he recovered. Patient was quite blanched from bleeding through rectum, caused by the two internal hæmorrhoidal tumours.
- 58.—Male, aged 20. On hæmorrhoids (5 minutes). Pulse and respiration probably failed together. Operation finished, when at once respiration ceased, features becoming lividly blue, eyeballs turning upwards; patient seemed moribund. Shirt ripped open all down. The surgeons and assistants took part in the measures adopted as follows: Two at patient's arms for Sylvester's method of artificial respiration (relieving guard); one at feet (counter-resistance); one to admit fresh air; one to turn face on left side, hold tongue forward, wipe mouth; one to spank face and chest with cold wet towel. Recovered perfectly in 7 minutes. Had taken chloroform in New York infirmary in 1870. Of fine frame, with no cardiac lesion. All being able to fall to work readily for resuscitation conducted to success. "Inclined to prefer 6 reliable assistants to any number of galvanic machines."
- 59.—Female, aged 27. For chronic disease of hip-joint; exploration; 4 minutes. Pulse failed first. Patient showed no signs of returning consciousness, so window was opened and face and chest flapped with wet towel. But pulse became more irregular and sank alarmingly. Inversion (Nélaton's method) repeated 4 times, between which patient made an apparent recovery each time; the last was successful. Injection of brandy, egg, and beef tea; sprinkling of face with water refrigerated with ice; and artificial respiration also made use of. After 2nd inversion patient recovered consciousness and power of speech for a while. No pallor till after 2nd inversion. Did not get over symptoms of chloroform poisoning for 3 days. Weak, anæmic, and hysterical. Chronic and cataleptiform case of chloroform poisoning. This case, together with Nos. 60 and 61, can hardly be attributed to continuous chloroform poisoning, it being doubtful whether chloroform remains even an hour in body after it has been given; moreover, same symptoms occurred in case under nitrous oxide. More probable that there is formed in body an organic compound which, like amyl and sulphur compounds, produces cataleptic condition. If this be so, a volatile narcotic would give a start to action of narcotic already in body, which would be sustained after producing agent was eliminated from body.
- 60.—Female (young adult). Remained unconscious for 3 days, but recovered without ill effects.
- 61.—Female (young adult). In a few minutes burst into fit of laughter, then became unconscious. Various measures used to restore patient, it being supposed she was still under influence of chloroform. After 36 hours a medical man was sent for. He found patient profoundly insensible and breathing feebly. Valerian was given, and in a few hours unconsciousness passed away.
- 62.—Female. Radical cure of vesico-vaginal fistula. Pulse and respiration failed simultaneously. The operation was almost completed when pulse and respiration ceased. Immediately at Nélaton's order the body was inverted, the head hanging down while the heels were raised in the air. The jaws were held open and tongue drawn out, and artificial respiration performed. It was 15 or 20 minutes before signs of returning life were seen. When the pulse and respiration were fully established the patient was restored to the horizontal position, when she fainted again. The same measures were adopted with success; but she fainted again when placed horizontally.
- 63.—Child. Apparently dead. Inversion and suspension by feet, and forced movements of chest (Nélaton's method).
- 64.—Female, aged 18. Extraction of tooth. Chloroform given in cone-shaped napkin. Pulse and respiration failed together. When tooth had been extracted did not return to consciousness. Pulse small and feeble, and together with respiration soon failed. Was laid on bed. Muscular system relaxed, lips, face, and hands livid, breathing and pulse having ceased. Inversion by Nélaton's method together with artificial respiration. Was laid on bed again, but breathing and pulse failed. Was removed, and artificial respiration again resorted to. When laid down again, spasmodic twitches of muscles followed, with inclination for deep sleep, so spine was stimulated and feet put into almost scalding water, which roused patient thoroughly.
- 66.—Male, aged 9. To facilitate suture of wound of hand. No evidence of breathing and no pulse at temple or wrist. Head placed on floor and legs held perpendicularly; window opened, cold water dashed on face, and artificial respiration. Feeble respiratory effort ensued, followed by vomiting. Mouth became closed through tongue slipping from hand of operator. Jaws relaxed, though another attempt at vomiting; tongue held firm till breathing was established, and pulse perceptible. Kept inverted for another 5 minutes. Patient laid down, reclining at acute angle, went to sleep, and recovered. Recorded to show the advantage of Nélaton's method over artificial respiration in horizontal position.

- 67.—Male. Pulse and respiration failed together. Became suddenly faint; blue lips; blood turning black; breathing very imperfect. Nitrite of amyl (3 drops) caused return of respiration and pulse with vomiting. Patient boy, pale, fat, blue lips and cheeks.
- 68.—Female. Pulse and respiration failed together. Became blue in face and stertorous (tongue falling back). Lint with 10 drops of nitrite of amyl was placed over nose and mouth. In a few seconds blueness and stertor gave way to good colour, regular breathing, sickness, and vomiting. Patient middle-aged.
- 69.—Male, aged 6. Staphyloma of left eye, 3 minutes. Chloroform on flannel on wire frame. Pulse and respiration failed together. Anaesthesia obtained with some difficulty. Operation performed successfully; when patient became suddenly deathly pale with corpse-like appearance and colourless lips; the heart had ceased beating; both pulse and respiration had stopped. Jaws forced open and tongue drawn out. Patient held up by feet, entirely upside down, supported by operating chair. Artificial respiration then commenced. After $\frac{1}{2}$ minute of this suspension by feet, and strong pressure on the thorax repeated 16 times, colour returned to face, and some glairy viscid matter was vomited. Artificial respiration continued for a minute, and the child then placed on the chair in a horizontal position, face inclined sideways, and a little lower than the rest of the body; windows opened wide, and patient's face and chest vigorously struck with hand and flipped with wetted linen cloth. Face remained pale; but, under this striking and flipping of the skin, pulse reappeared, thready at first, then became stronger. The respiration became regular, with frothy vomiting now and then in jerks. When the child was taken out into the air he fell into the slumber that usually follows anaesthesia, but respiration and circulation were normal. After dressing, placed on a bed near window; was in state of stupor several hours, interrupted by attacks of vomiting, which were frequent in the evening 10 hours after operation. Passed a good night and recovered. Patient quite blind, just a small perception of light left. "The chloroform employed had already been partly used some days before; there was nothing in its odour that could suggest the fear of a fatal result.
- 70.—Female, aged 7. Division of internal recti for strabismus. 1 dr. of chloroform given. Pulse failed first. Pallor, cessation of heart-beat, dilatation of pupils, failure of respiration and pallor exchanged for deep lividity. Patient turned on left side, pressure applied beneath heart, chin drawn away from sternum, and jaws separated by finger. No signs of recovery, so tongue drawn out by artery-forceps. Respiration was soon re-established, the faintness passing away with an attack of vomiting and on face being sponged with cold water. The parents of patient were strictly enjoined to give her no food after a certain time before operation; but this order was not carried out.
- 71.—Female. Dilatation of intolerant fissure of anus. Small quantity of chloroform only. Patient soon came under with prior excitement, and after the operation had been performed, remained deeply under, the thorax being quite immovable and pulse very feeble. The various efforts at restoration had to be continued $\frac{3}{4}$ hour before respiration was completely re-established. Very nervous temperament. Pregnant 2 months.
- 72.—Female, aged 40. Dilatation of anus. Small quantity of chloroform only. After 4 or five inspirations she fell into a state of resolution without prior excitement. The patient came to almost immediately after the operation, which took only a moment. Reporter says that had the chloroform been continued "disastrous results might have ensued." Patient was nervous.
- 73.—Female, aged 7. For strabismus. After the operation was finished patient suddenly ceased breathing, and there was no radial or carotid pulse. Holding up by ankles and artificial respiration made while in that position. Breathing was restored, but ceased on laying her down; was raised again, and breathing restored; laid down again, and breathing failed for longer time than before. The same means at last restored her; vomiting followed at once and consciousness returned.
- 74.—For anal fissure. Small quantity of chloroform. Pulse and respiration probably failed simultaneously. Anaesthesia quickly induced. No excitement. Patient relapsed into a state of profound coma, respiration ceasing and pulse becoming very feeble. This slow form of death from chloroform has been called by M. Perrin the "adynamic" in contradistinction to the more sudden form called the convulsive. Resuscitation very difficult. Great excitation of the nervous system follows these so-called intolerant fissures of the anus, which is liable to influence the susceptibility of the patient to the influence of chloroform.
- 75.—For anal fissure. Symptoms very alarming. Chloroform discarded and instant dilatation resorted to.
- 76.—Male, aged 60. Removal of large epithelioma by means of galvanic *écaiseur*. Clover's inhaler used. Respiration failed first. Pause in breathing. Chloroform tube removed, but inhalation continued by nose-cap, as respiration good and stage of operation important. Respiration began again, but feeble, so chloroform discontinued. Pressing upon chest and abdomen; drawing forward tongue (ligatured); artificial respiration (Silvester's method). These means failing, laryngotomy performed. When laryngeal tube inserted Silvester's method successful. To complete operation more chloroform given; laryngeal tube acting well. Operation completed, patient making good recovery.
- 77.—Female. Dental operation. Patient almost lost her life. On recovering consciousness it was found that tongue had almost been divided in two by the teeth.
- 78.—Female, aged 49. Removal of fatty tumour in left lumbar region. 2 dr. chloroform only used. When just about to pass into third stage made an abortive effort to vomit and raised head from pillow; pulse flickered and stopped; patient gave gasp; foam gathered on lips; jaw became rigid; was apparently dead. Dashing cold water on face; pulling tongue forward; artificial respiration (Marshall Hall's method), without success. Nitrite of amyl on lint held to nostrils; pulse and respiration restored. Anaesthesia still being present, operation performed. There was, by inference, syncope from paralysis of heart, and this was met by nitrite of amyl, which gave a flip to the arrested circulation.
- 79-80.—[1876]. Pulse failed first in each case. The symptoms noted were sudden failure of pulse, lividity of countenance, feeble respiration, and the measures adopted for resuscitation were: Discontinuance of anæsthetic; pulling forward tongue; artificial respiration; free current of air.
- 81.—Female, aged 7. Enucleation of eye-ball for sarcoma of choroid. Speculum introduced; globe of eye burst; prolapse of vitreous; globe enucleated, followed by free bleeding. Patient became faint and suddenly collapsed. Immediately inverted by raising legs and suspending with head downwards; tongue drawn forward; deep inspiration followed, and natural breathing, and healthy colour restored. Delicate feeble child.
- 82.—Male, aged 36. For catheterism for rupture. Respiration probably failed first. The patient suddenly ceased breathing, and appeared moribund. Artificial respiration (Silvester's method); drawing tongue and larynx well forward. Tracheotomy performed, and artificial respiration re-commenced; much blood sucked into trachea and coughed up. Colour of face became normal, and spasm of the glottis disappeared. Recovery, but operation abandoned for the time. Operation performed under ether on another occasion. (See *Ether Untoward Cases*, Series B, No. 13.) With ether, the dangerous spasm came on before anaesthesia was very profound; with chloroform, spasm came on at later stage, and was accompanied by paralysis of respiratory muscles as if nervous centres more deeply affected.
- 83.—Female, aged 22. Labour (to relax uterus in aid of version). Pulse and respiration probably failed simultaneously. The symptoms given are: Ceased breathing and became pulseless. With difficulty resuscitated and slightest inspiration of chloroform reproduced alarming symptoms. Strong, healthy, free from heart or lung affection.
- 84-85.—Female, aged 30. (1) For labour. Respiration probably failed first; after 6 deep inspirations, ceased breathing. Restored by Marshall Hall's method. (2) For labour. Chloroform given on handkerchief (small dose). Respiration probably failed first. Breathing ceased. Restored by Marshall Hall's method. These two cases and No. 83 are recorded to show that patients in labour do not enjoy an absolute immunity from the pernicious effects of chloroform. Patients free from cardiac or pulmonary complications.
- 86.—Female. Marion Sims' operation 30 minutes. $3\frac{1}{2}$ drs. given in Junker's modification inhaler. Respiration failed first. Semi-anæsthetic state produced in 2 minutes. Respiration slow and shallow from the first. Pulse fair. Beef-tea and brandy administered with view of meeting the syncope which was expected. When left under care of operator pulse was slow and feeble. Patient was semi-conscious and complained of the operation. Syncope lasted for 6 hours, when she was sick. Had suffered from almost fatal syncope on one occasion, and very severe syncope on another, after administration of nitrous oxide gas.
- 87.—Infant, one month old. For harelip. A few minims given in a Junker's modification inhaler. Respiration failed first. Operation nearly completed, child struggling and feebly crying when respiration stopped and the deathly pallor ensued. The child was inverted and a teaspoonful of blood ran from its mouth. Artificial respiration kept up. Heart felt to be beating strongly. Respiration was restored with a good cry.
- 88.—Male, aged 11. Removal of pea from ear. 30-35 minims of chloroform given on a handkerchief. Pulse failed first. Scarcely had the inhalation ceased than the boy's pulse entirely failed. Efforts of the usual kind for restoration were tried in vain for 20 minutes. His head and upper part of body were then thrust out of the window to try the effect of the cool air, but as no effect was produced one of the assistants seized hold of the boy by the legs and hung him out of the window with his head downwards, swinging him to and fro like a pendulum. After 4 or 5 minutes of this procedure, the boy's face became red and he uttered a cry. The respiration and circulation were restored after more than half an hour's arrest.
- 89.—Male. Pulse and respiration failed together. Heart and re-

spiration became suddenly arrested. Half an hour afterwards, amongst other means for restoration, he was bled, and gas was observed in the stream which flowed from the vein. Half an hour later he made his first independent inspiration.

- 80.—Male, aged 24. Cañtery for injury to spine. Pulse and respiration failed together. At first pulse and breathing good, but respiration ceased suddenly and completely. Mouth and rima glottidis cleansed from mucus; head allowed to hang over edge of bed for few seconds; body placed on floor and needle and thread passed through tongue which was held forwards; artificial respiration, cold water thrown on body and ammonia to nostrils. After 6 minutes with more artificial respiration heart began beating but no breathing. Hard slaps, cold water on face and chest, blowing down fanes, tried, but useless. At last deep inspiration, then others. Galvanic battery tried with (accidentally) full force of current from 50 cells, but this suddenly and successfully resuscitated patient. This was the 5th time the operation had been performed, each time under chloroform. Patient cheerful and intelligent. Spare, fair and boyish-looking. Had lost all sensation and voluntary movement below waist.
- 91.—Female. Ovariectomy. Pulse and respiration failed together. Operation had just been commenced when respiration suddenly stopped and the heart ceased to beat—bleeding ceased and lips of wound bloodless. Mouth cleansed from mucus, tongue drawn forwards, patient's head thrown well back and artificial respiration for 10 minutes—without result. Case almost desperate when surgeon put large cloth in boiling water and applied it to cardiac region. Pulse and respiration returned, operation not terminated.
- 92.—Female. Removal of uterine polypus. Pulse and respiration failed together. Operator had just passed hand into vagina and was about to apply *écraseur* when pulse suddenly stopped. Respiration ceased almost simultaneously. Jaw dropped and tongue lay between teeth. Percussion of heart, artificial respiration (Silvester's method), cold affusion, and hypodermic of ether tried with no avail for 3 or 4 minutes. Patient then seized by shoulders and placed on floor and legs elevated. Pulsation in neck began. Was placed on bed. Distinct cardiac action but respiration suspended; again pulse grew feeble. Re-inverted for 2 minutes; strong palpitation began, followed by few gasps. Several distinct clonic convulsions of right side. Respiration became natural, and after 5 minutes of quiet sleep patient awoke. Operation deferred. Had been put under chloroform for same operation on 31st of October, 1880. Took anæsthetic well. Present operation took place 6th of March 1881. How far interference with genital organs provoked the syncope could not be said. Operations on testicle not thus provocative if chloroform narcosis deep enough. Midwifery experience against such a presumption. It was possible that the powerful stimulating properties of the ether was overbalanced by the addition to the narcosis.
- 93.—Male, aged 66. Removal of upper jaw. Chloroform given through nasal catheter. Respiration failed before pulse. Short time after commencement of operation, respiration became shallow and at length ceased. Heart's action kept up with vigour. Artificial respiration. Patient recovered, but did not make any efforts at breathing till the artificial respiration, had been kept up 10 minutes, together with tickling his sides, which had the chief effect. Operation then proceeded with; only small quantity of anæsthetic given; respiration occasionally threatening to cease. Patient died 2 days after operation, apparently from exhaustion. Post-mortem. Lungs emphysematous, right adherent. Heart: slight fatty degeneration of muscle.
- 94.—Male. For cleft palate (1 hour). Pulse failed first. Had been on table nearly 1 hour when pulse began to flag, which at last could not be felt at wrist. Cessation of respiration followed. Gag being removed and head lowered, preparatory to artificial respiration, both pulse and respiration were established. Patient not deeply under influence of chloroform, owing to depressed condition, vomiting and loss of blood.
- 95.—Male. For relief of nephritic colic. Pulse probably failed first. Pulseless, gasping for breath; apparently dead. 1 dose of morphine (hypodermic) had been given (with hot bath) before chloroform, and with chloroform a dose of morphine by the mouth and dose of morphine and atropine (hypodermic). Pain suddenly relieved (probably by passing the calculus from ureter into bladder), but "sudden relief from pain caused narcotics to have the greatly increased effect." Was resuscitated after efforts of 2 hours. See also New York Medical Record, September 2, 1882, p. 274. Here it is considered that the well nigh fatal result was due to *inhalation of chloroform* while giving morphine.
- 96.—Female, aged 19. Excision of elbow-joint for ankylosis. 2-4 drs. given. Respiration failed first. Operation hardly begun when breathing completely stopped. Face became pallid, but pulse was felt in radials throughout. Artificial respiration (first direct, then Silvester's method) was kept up with momentary stoppages; windows opened; chest with shoulders raised, and head thrown back and lowered; was flipped with cold water towels, &c.; faradaic current applied, one pole over phrenic, other over epigastrum. This brought on action of diaphragm and abdominal muscles of expiration, greatly aiding voluntary respiration, now almost restored. This followed by prolonged drowsiness; stimulants administered; cold water dashed in face and ribs kneaded. After restoration from effects of chloroform, heart examined and pre-systolic roughness found in mitral area. Had scarlet fever when 10 years old. Her father died of heart disease, aged 58. Patient had taken chloroform well 3 days before. Operation successfully performed under ether a week later.
- 97.—Female, aged 5. For diagnosis for vesical calculus. 1 dr. of chloroform given. Pulse and respiration failed together. Greyish lividity, gasping for breath, cessation of heart-beat. Ether injection in leg; inversion; intermittent pressure on chest walls; holding lower jaw forward. Breathing and pulse returned, but both very feeble for $\frac{3}{4}$ hour. Inversion continued for 1 hour. When patient was laid down (which was twice in hour), face became pale and pulse flickered. Full restoration after 2 or 3 hours. Heart and lungs healthy.
- 98.—Male, young adult. Removal of right middle finger at centre of metacarpal bone. Chloroform given on handkerchief forced into cone. Pulse and respiration failed together. No blood flowed from wound, and expression of face became deathlike. Pulse barely perceptible, and had almost ceased to breathe. Strong friction with turpentine on the limbs and trunk towards the heart after a time restored animation.
- 99.—Patient, aged 3. For cancer of left eye. Pulse and respiration failed together. Operation had proceeded no further than division of the conjunctiva when respiration ceased, and also pulse at wrist. 3 or 4 times anæsthesia had to be stopped, child being held head downwards, and operation being performed while child thus suspended. Inverted position kept up $\frac{3}{4}$ hour.
- 100.—No particulars.
- 101.—Boy. For crushed thigh. Appeared to be dead. Was inverted till life re-appeared.
- 102.—Death seemed imminent, from stoppage of heart. Heart stimulated to contraction by pretty heavy blows administered with open palm over the cardiac region.
- 103.—Male, aged 10. Extraction of teeth. Pulse failed first. Before operation was begun, pulse very weak. Chloroform withdrawn, and pulse became strong. Chloroform re-applied; pulse again failed, but returned when chloroform removed. 10 minutes after, ether used, with Clover's inhaler, and pulse became full and strong. Teeth successfully extracted.
- 104.—Female, aged 5. ($\frac{1}{2}$ minute.) Pulse and respiration failed together. Appeared quite dead, pulse and respiration ceasing at same moment. Artificial respiration; but as natural colour was leaving face, and replaced by livid pallor, nitrite of amyl also used, being held to mouth as air produced by artificial respiration was passing in and out. At last there was a sound as if vocal cords were moving; artificial respiration still kept up, but upon cessation for a moment patient was found to be naturally breathing. It was 5 minutes after the commencement of taking measures before signs of life appeared. It was considered that without the nitrite of amyl the child's life would not have been saved. The cause of apparent death was that although utmost pains had been taken to keep the child from eating anything, she had managed to devour an apple, of which, on becoming conscious, she vomited stalk, core, and part of skin. The indigestible matter appeared to have caused reflex paralysis of cardiac and pulmonary centres, as at no time was there any obstruction to passage of air. Child had apparently taken no food, and clothes were loose when chloroform given and everything in order. Had been anæsthetised 3 times before without anything unusual occurring.
- 105.—Male, aged 14. Cantering chronic ulcer. Respiration failed first. While dressing was being applied and after chloroform had been removed patient suddenly ceased to breathe. Rolling (Marshall Hall's method); this done for several minutes, but hands became cold and lips purple. Nélaton's method resorted to; the boy's legs were flexed over shoulders of administrator, head and legs dangling to the floor; was thus carried, at running pace, round room for 3 minutes, until respiration returned by degrees. Was again laid on table. Breathing again became arrested; resort had a second time to suspension, which was followed soon again by restored respiration. Vigorous and healthy; taking the anæsthetic kindly; all being effected without any difficulty.
- 106.—Female, young adult. For entropion. Respiration failed first. When about half through operation respiration suspended, and all efforts to restore it ineffectual. Suspension resorted to, as in last case, and breathing at length restored. Was of large size. Took anæsthetic badly.
- 107.—Female, aged 7. Tenotomy for strabismus. Probably respiration failed first. Struggling during administration, but no untoward symptom till operation completed, when respiration failed and pupils became dilated at same time. Marshall Hall's method commenced with no success. After some time the child was suspended, and carried round the room by surgeon, then placed on table, and it was found that breathing was noiseless and regular, and the period of consciousness was almost reached.
- 108.—Male, adult. On testicle. Respiration failed first. Toward-

close of operation no chloroform was given, and breathing was regular. Suddenly breathing ceased and lips became ashen. Rolling at once resorted to, but failed. Suspension then tried, a few turns about room effecting restoration of function, and patient was again placed on table.

- 109.—Female, aged 40. Removal of growth on tongue (more than 7 minutes). Chloroform given in Junker's inhaler with foot-bellows attachment; 3 dr. Pulse failed first. Patient was very excited and talkative; anaesthesia nearly complete, when she became rather pale. At first nothing wrong in temporal artery, but right radial very feeble and none in left; then temporal pulse failed, pupils becoming widely dilated, and respiration shallow and irregular. Administration not discontinued till after pupils dilated and respiration all but stopped (*THE LANCET*, Oct. 3, 1891, p. 789). Head lowered, artificial respiration, and application to nostrils of capsule con-

taining 3 min. nitrite of amyl. After a minute some colour returned to face, and patient made some attempts to breathe. Brandy enema administered, and friction applied over cardiac area; gradually pupils contracted, and pulse was re-established. Directly after patient began to retch, and brought up a little fluid, and shortly regained consciousness. On auscultation being made as she was recovering consciousness, the cardiac sounds, while plainly audible at apex and over pulmonary valve, were almost inaudible over aortic valve; however, they quickly returned, patient became conscious, and complained of nausea. It was found out afterwards patient had taken sulphonal, without permission, the night before, and for some days afterwards pulse remained very compressible. Patient highly nervous, but otherwise healthy. The application of nitrite of amyl considered to have been of great value in this case.

SERIES C, I.—REPORTS OF UNTOWARD CASES FROM AUTHORITIES OF HOSPITALS IN REPLY TO THE LANCET INQUIRY.

- 1.—Male. Circumcision. Respiration failed first. Breathing suspended 1 or 2 minutes ultimately resumed. No particulars given as to resuscitative measures adopted. Child was epileptic.
- 2.—A few cases. Chloroform given on towel or handkerchief. Alarming; particulars not given. Artificial respiration; stimulants; plenty of fresh air.
- 3.—Male, aged 29. Fistula in ano (9 minutes inhalation). Esmarch's inhaler used. Respiration failed first; pulse feebly beating. Inversion; artificial respiration (10 minutes). Healthy; operation finished without use of anaesthetic; breathed after $3\frac{1}{2}$ minutes of artificial respiration.
- 4-7.—Stretching anal sphincter. Chloroform given on flannel on wire frame. Respiration probably failed first. Inversion together with artificial respiration.
- 8-28.—Chloroform given on flannel on wire frame. Respiration probably failed first. Inversion together with artificial respiration.
- 29.—Female, aged about 30. Necrosis of tibia. Snow's inhaler used. Respiration failed first. 2 or 3 minutes after commencement respiration stopped whilst heart was beating. Artificial respiration.
- 30.—Children. Respiration failed first, failing on completion of operation, and when administration had ceased. Artificial respiration.
- 31.—Several cases. Pulse failed first. Sudden blanching of skin, coldness, feeble pulse, and every symptom of cardiac failure; breathing slow and shallow. Patients at once revived by administering ether. Chloroform supplied by a firm other than the one usually supplying hospital. No chemical analysis made. No recurrence of untoward symptoms under fresh lot of chloroform ordered.
- 32.—Several cases. Respiration failed first. Artificial respiration and inversion.
- 33.—Respiration failed first. Artificial respiration.
- 34.—Male, aged 13. Diseased bone. Chloroform given on lint. Collapse, operation had to be stopped. Artificial respiration. Weak, anæmic; health improved when subsequent operations were performed. Soon after admission a very large abscess opened under chloroform, brandy and water having been given previously. No accident occurred. 2nd time he had chloroform without antecedent stimulant; collapse occurred. On 3rd occasion his thigh was amputated under chloroform; antecedent stimulant given; no accident. On 4th occasion stimulant was omitted, and collapse occurred. On 5th occasion stimulant given; no untoward symptoms.
- 35-38.—All children. Respiration failed first. Breathing ceased, with intense pallor. Artificial respiration.
- 39.—Circumcision (10 minutes). Chloroform given on towel. Respiration failed first. Breathing stopped. Artificial respiration; flicking with wet towel. Feeble infant. Dorsal decubitus.
- 40.—Male (elderly). Amputation of penis ($\frac{1}{2}$ hour). Chloroform given on towel. Respiration failed first. Breathing stopped. Artificial respiration; wet towel; injection of ether.
- 41.—Male, aged 61. Amputation of thigh ($1\frac{1}{2}$ hours). Chloroform, 6 dr., given in a Junker's inhaler. Pulse failed first. Pulse very weak at times.
- 42.—Male, aged 75. Removal of tongue. Chloroform given in Junker's inhaler. Respiration failed first. Breathing at one time bad.
- 43.—Male, aged 68. Removal of left lower jaw. Chloroform given in Junker's inhaler. Pulse and respiration failed together. Breathing stopped early in operation; pulse also weak. Inversion; quick recovery.
- 44.—Male, aged 35. For empyema. Chloroform given in Junker's inhaler. Pulse failed first. Pupils became very dilated, just as anaesthesia complete; no conjunctival reflex; was struggling a little. Pulse very slow, though fair power.
- 45.—Male, aged 36. Pneumotomy for gangrene of lung. Chloroform given in Junker's inhaler. Respiration failed first. 2 slight epileptiform fits while going under. Towards end of operation, stopped breathing; became livid. Fair pulse; pupils normal. Artificial respiration; recovery.
- 46.—Male, aged 74. Neurectomy, for neuralgia of stump. Chloroform given in Junker's inhaler. Pupils very dilated; no other bad sign.
- 47.—A few cases, all women. Alarming (no particulars).
- 48.—No particulars.
- 49.—Male, aged 30. Removal of hemorrhoids. Chloroform given in wire mask covered with flannel. Artificial respiration.
- 50.—Female, aged 55. Removal of breast. Chloroform given in wire mask covered with flannel. Head on lower level; artificial respiration.
- 51.—Male. Chloroform given in Skinner's inhaler. Had epileptiform attack. Same patient was given ether on a former occasion with untoward results. (See *Ether Untoward Cases*, Series C.)
- 52.—Male, 50-60. Chloroform given in Skinner's inhaler. Respiration failed first; stopped breathing; pulse kept going. Promptly raising legs; drawing chin and tongue well forward; artificial respiration (Silvester's method). Recovery.
- 53.—Infant. Chloroform given in Skinner's inhaler. Respiration failed first. Stopped breathing; pulse kept going. Promptly raising eyes; drawing chin and tongue well forward; artificial respiration (Silvester's method). Recovery.
- 54.—Several cases. Chloroform given on towel. Respiration failed first.
- 55.—Several cases grouped together as occurring in India with remarks we have epitomised as follows: Spirit drinkers and eaters of animal food most subject to danger; abstainers from such could be safely anaesthetised by chloroform. Danger often from timid or sparing use of chloroform.
- 56.—A further report from India of "many cases," only general particulars being given as follows: Chloroform given from a cup inhaler, with a hypodermic injection of morphia. Respiration failed first in these cases. One patient became deadly pale. Partial inversion; other cases artificial respiration; sometimes galvanism.
- 57-60.—Respiration and pulse failed together. Pulse gave no indication; lividity and stoppage of breathing occurred almost simultaneously. Cases 57, 58, and 59, inversion of body; Case 60, forcible extension of chin. In all, artificial respiration for 2 minutes, together with application of ammonia to nostrils, and naked chest slapped sharply with wet towel.
- 61.—Male, aged 12. 1 dr. of chloroform. Respiration failed first. Respiration ceased completely; pulse good; pupils not dilated; no change in colour. "Anaesthetic withdrawn." No other particulars given.

SERIES C., II.—REPORTS OF UNTOWARD CASES FROM PRIVATE PRACTITIONERS IN REPLY TO THE
LANCET INQUIRY.

- 1.—Male, aged 35. For ruptured gall bladder. Chloroform given in Skinner's frame. Respiration failed first. Failing pulse was the first symptom which elicited notice. Inversion was successfully practised. Shock was believed to be the immediate cause of the collapse.
- 2.—Male, aged 40. ? Limb. Chloroform given in Skinner's frame. Respiration failed first. Failing pulse first symptom noticed. Inversion practised. Shock was believed to be the immediate cause of the collapse.
- 3.—Male. ? Limb. Chloroform given on folded lint. Respiration failed first; respiration ceased suddenly. Inversion; artificial respiration (Howard's method); cold affusion with ammon. carb. cautiously applied to nostrils. Not particularly feeble.
- 4.—Female, aged 54. For cancer (20 minutes). Chloroform given on folded lint. Respiration failed before weakening of pulse. Head lowered, jaw pushed forward; artificial respiration; subcutaneous injection of ether. Fat and short-winded; ? probably fatty heart.
- 5.—Female, aged 50. Scirrhus (15 minutes). Chloroform given on folded lint. Respiration failed before weakening of pulse. Head lowered, jaw pushed forward; artificial respiration; subcutaneous injection of ether. Suffering from chronic bronchitis.
- 6.—Female, aged 40. Scirrhus (7 minutes). Skinner's frame used. Respiration failed first. Heart very feeble. Inversion. Spare; dorsal posture.
- 7.—? Male. Removal of tumour. Steven's inhaler used. Respiration and pulse failed nearly together. Inversion, &c.
- 8.—Male, 7 months. Respiration failed first. Respiration ceased after 4 minutes; resuscitation difficult.
- 9.—Male, aged 2. Duration 2 minutes. Chloroform on towel. Respiration failed first. Artificial respiration.
- 10.—Male, aged 25. Little finger (10 minutes). Cone, with lint in it. Respiration failed first. Breathing ceased; pulse continued. Artificial respiration successful after 15 minutes. Healthy.
- 11.—Aged 6. Not stated which joint. Methylated chloroform on napkin. Respiration failed first. Stertor, lividity, failing respiration. Artificial respiration.
- 12.—Male, aged 20. Cataract. Chloroform on napkin. Respiration failed first. Stertorous breathing; lividity; failing respiration. Artificial respiration; battery (20 minutes).
- 13.—Male, aged 10. Tenotomy for strabismus (5 minutes). Given on lint. Respiration failed first, ceasing on section of tendon. Artificial respiration. Heart and lungs were healthy.
- 14.—Male, aged 31. Leg. Given on lint. Respiration failed first. Much struggling, patient became cyanosed, breathing rapid and stertorous, pulse just perceptible. Artificial respiration; faradic current; hypodermic injections of ether and brandy. Had delirium tremens. Heavy drinker with hepatic enlargement; no evidence of cardiac disease.
- 15.—Male, aged 38. Catheterism. Given on lint. Respiration failed first. Much struggling; patient became cyanosed, breathing rapid and stertorous. Pulse just perceptible. Artificial respiration; faradic current; hypodermic injections of ether and brandy. Had delirium tremens; had wounds on face so that Clover's facepiece could not be used. Heavy drinker with hepatic enlargement; no evidence of cardiac disease.
- 16.—Male, middle-aged. Forceful catheterism (a few seconds). Skinner's inhaler used. Respiration failed first. No particulars given about measures of resuscitation employed. A n intemperate seafaring man with almost complete urethral stricture. Death probably due to effects of chloroform and uremic poisoning. (See Deaths, Series C, Hospitals No. 10, p. 154.) This patient recovered from the immediate consequences of the anæsthetic although he eventually died. Hence the case appears under two categories.
- 17.—Male. Cystotomy for cystitis. Chloroform given (small towel). No particulars are given as to the symptoms which gave rise to fear, but it is expressly stated that they were the result of the anæsthetic having been given in an injudicious manner by a timid chloroformist. Lowering head; opening window; a few slaps on the head with wet towel; successful.
- 18.—Male. Lithotomy. Respiration, which failed first, ceased suddenly. Inversion; artificial respiration (Howard's method), cold affusion with ammon. carb. cautiously applied to nostrils. Not particularly feeble.
- 19.—Male, aged 18. Lateral lithotomy (10 minutes). Given on folded lint. Respiration failed first. Tetanic spasms, which affected respiration. Silvester's method of artificial respiration. Weak and emaciated. Occurred twice in same patient, once in 1888 and again in 1890.
- 20.—Lateral lithotomy. Junker's inhaler used. Respiration failed first. Silvester's method of artificial respiration, with pressure under angles of lower jaw to keep tongue clear. Patient recovered without any bad symptom.
- 21.—Male, aged 6. Sounding for stone (10 minutes). Chloroform (towel). Respiration probably failed first. Artificial respiration; electricity to vagus; respiration restored in $\frac{1}{2}$ hour.
- 22.—Male, aged 5 $\frac{1}{2}$. For phimosi-s. Skinner's mask used. Respiration failed first. Artificial respiration for 3 minutes.
- 23.—Female, aged 31. Dilatation of cervical canal (10 minutes). Given on a handkerchief. Respiration failed first. Artificial respiration.
- 24.—Female, aged 45. Fibroma of uterus. Chloroform (Skinner's frame). Respiration failed first. Inversion. Heart very weak; spare woman.
- 25.—Children. Exploratory examination of hip disease. Chloroform (lint). Respiration failed first. Artificial respiration and inhalation of ammonia.
- 26.—Excision of epithelial cancer of lip. Junker's inhaler used. Respiration failed first. Silvester's method of artificial respiration, with pressure under angles of lower jaw to keep tongue forward. Patient recovered without any bad symptom.
- 27.—Removal of large tumour from jaw. Respiration, which failed first, ceased suddenly. Inversion; artificial respiration (Howard's method); cold affusion with ammonia carbonate cautiously applied to nostrils. The patient was not particularly feeble.
- 28.—Removal of tumour from jaw. Respiration failed first. Ceased breathing suddenly. Chest wall very rigid and seemed to crack on pressure. Inversion; artificial respiration (Howard's method); cold affusion with ammoniac carbonate cautiously applied to nostrils. Not strong; had had sloughing tumour of upper jaw.
- 29.—Male, aged 10. For pus in joint. Skinner's frame used. Respiration failed first, but no particulars given as to means adopted for resuscitation.
- 30.—Opening knee-joint for acute suppuration. Chloroform given on towel. Pulse failed first and stopped suddenly. Inversion; hypodermic of ether; subsequently artificial respiration, which was successful. The patient was an epileptic.
- 31.—Male, aged 52. Tying external iliac. Chloroform given on lint. Became livid, apparently from dropping back of the tongue, and lower jaw could not be elevated owing to scar tissue. Tongue forcibly pulled out by forceps, and so held. A.C.E. mixture substituted.
- 32.—Male, aged 23. Talipes equino-varus. Given on lint. Pulse and respiration failed together. Breathing suddenly stopped; extreme pallor; pulse imperceptible. Artificial respiration; current (faradic), one pole to phrenic on neck and other over cardiac area. Breathing not established till after 30 minutes. Patient had extreme cleft palate.
- 33.—Male. Foot torn off by machinery. Steven's inhaler used. Collapse. When dangerous symptoms occurred A.C.E. mixture substituted with benefit. The accident caused severe hemorrhage, which determined patient's death the same evening.
- 34.—Male, aged 20. Removal of enlarged and ulcerated scrofulous glands (10 minutes). Junker's inhaler used. Respiration failed first. Silvester's method of artificial respiration. Patient quite well in one hour. Weakly.
- 35.—Female, aged 42. Removal of dead fœtus (2 minutes). Chloroform (Skinner's frame). Respiration failed first. Inversion successfully practised. Lateral posture. Patient fat, with granular kidneys.
- 36.—Male, aged 25. For hemorrhoids (5 minutes). Chloroform given on lint. Respiration failed first; heart continued active. Cold affusion to face and chest; artificial respiration. Patient was difficult to bring under influence of chloroform. A strong man of full habit.
- 37.—Adult. Extraction of tooth. Chloroform given in a cone-shaped towel. Pulse failed first. Pulse became weak after 2 or 3 minutes' use of anæsthetic. Reclining posture.
- 38.—Female. For tumour. Chloroform (bandkerchief). Pulse failed first. Artificial respiration.
- 39.—44.—For tumour. Chloroform (handkerchief). Pulse failed first. Artificial respiration.
- 45.—Removal of fatty tumour. Chloroform. Respiration failed first. Inversion.
- 46.—No particulars. Dorsal posture.
- 47.—48.—Infants. Chloroform given on handkerchief. Pulse failed first.
- 49.—Children between 9 and 12. On handkerchief. Pulse failed first. Artificial respiration.
- 50.—Children. Chloroform on towel. Respiration failed first. Inversion; cold affusion.
- 51.—No particulars given. No very serious cases.
- 52.—On lint. No particulars given. No very serious cases.
- 53.—Chloroform; Junker's inhaler and lint used. No serious cases.
- 54.—Chloroform (lint). Respiration probably failed first. The reporter of this case had several dangerous cases. Speaks highly of the effect of nitrite of amyl, and suggests restarting respiration by lifting patient from recumbent to sitting posture. He thinks in all these cases respiration failed first.
- 55.—Male, aged 25. Chloroform (mask of lint). Respiration failed first. Artificial respiration; easy recovery.
- 56.—Children. Chloroform mask of lint). Respiration failed first. Artificial respiration; easy recovery.
- 57.—Children. Chloroform. Several cases caused anxiety. Artificial respiration always restored animation.
- 58.—Chloroform (towel over frame). Pulse probably failed first. Syncope. Artificial respiration; pulling forward tongue; lowering head, and raising arms and feet, successful in every case.
- 59.—62.—Chloroform (small towel). Cessation of administration of chloroform. Artificial respiration.

PART II.—ETHER.

The same course was pursued in studying this agent as in the case of chloroform, and the following statistics are presented. As we propose later to compare the anæsthetics with each other, we need not add to what we said in introducing the report with the statistics concerning chloroform.

INFLUENCE OF SEX AND AGE.

The mortality is slightly against the males, a fact explicable, as in the case of chloroform, by the greater liability to accident, and so to operation, in the case of males. But few deaths are recorded before the age of forty, or after that of sixty. The number of deaths before adult life and after middle life will be influenced by the frequency with which chloroform is selected in place of ether in these epochs of life. However, deaths are reported as early as at 6 years and as late as at 84.

From the statistics we learn that 30 males died under ether between the ages of 6 and 84, to 25 females between the ages of 6 and 74; that most deaths took place between 45 and 50, and this applies to both sexes; that nearly $\frac{3}{4}$ ths of the female deaths occurred between the ages of 40 and 50; that nearly half of the male deaths occurred between 45 and 55. It is curious that, taking deaths at all ages, we find that the average age at death under ether for the male is 46, and for the female 40.

GEOGRAPHICAL DISTRIBUTION

Without giving in detail a list of places from which records have reached us of fatalities under ether, it may be broadly stated that, while largely used in England, Ireland, and in the United States, but few cases have been reported from Scotland, the Continent, or from the Tropics. Ether, from its extremely volatile nature, is not employed to any extent in hot climates. At the close of our report we shall have occasion to draw attention to statistics bearing upon the question of the comparative frequency of the use of the various anæsthetics, which have an important bearing upon the geographical area of fatalities under anæsthetics.

CAUSES ASSIGNED FOR DEATH.

The cause assigned as the immediate or cognate factor in producing the accident is next to be considered. In order to do this it has been thought advisable, as in the case of chloroform, to give, as far as space allows it, the actual words used by the narrators of the cases under the headings of the leading symptoms which they gave. In some instances the reporter states his belief that the fatality resulted directly from the careless manner in which the ether was given.

Anæsthesia (imperfect).—Shock. Eclampsia, epileptic fit, Asphyxia.—From blood entering windpipe; hernia with vomiting; with incomplete anæsthesia; from respiratory spasm; from shock.

Asthenia.—The patient was *in extremis*, and on being moved took one or two inhalations of ether and died.

Bronchorrhœa, acute, due to impeded pulmonary circulation.

Cerebral conditions.—Ether acting on senile degenerate arteries of brain; nervous exhaustion following stimulation.

Collapse.—Intestinal obstruction; from shock; three days' strangulated hernia.

Embolism.—Cerebral.

Emphysema and bronchitis.

Ether.—Improper ether used (that meant for local anæsthesia only).

Exhaustion.—Bad case of blood-poisoning. Long-standing strangulated hernia.

Heart failure.

Heart and respiration, failure of, following severe struggling.

“Kidney disease” pre-existing.

Lungs, congestion of.

“Paralysis of heart.”

Pneumonia.—Following the exhibition of ether; bronchitis and renal complications.

Respiration, failure of.—Laryngeal diphtheria; in a case in which the operation was severe, and the death was said to be “probably only partially due to ether”; from interference with action of diaphragm due to distended bowel, or from asthenia from abdominal distension, or from mixing of brandy and ether increasing narcotising effect of latter.

Shock.—In case of operation for hernia: in case of death said to be “due not to ether.”

Suffocation.—From blood entering windpipe during operation on tongue.

Syncope.—Following hæmorrhage. From general debility (phthisical). From general debility (weakly strumous person). Hernia. Incomplete anæsthesia. “Kind of syncope” (emphysema).

? Syncope or Shock (severe smash).

Uremia.

FAILURE OF RESPIRATION AND OF THE CIRCULATION.

The importance of the point as to which fails first—respiration or circulation—has already been insisted upon, and in the present section we shall consider the question as regards ether. We have a record of 19 deaths under ether when the pulse failed first; 22 when the respiration failed first; and 10 cases are given in which the circulation and respiration appear to have ceased simultaneously.

THE NATURE OF THE OPERATION.

We next pass to the operations which were in progress, or had just been completed, when the death occurred. The same classification has been adopted as that employed in dealing with chloroform.

Amputation.—At ankle; of fingers; of leg; through thigh.

Abdomen (operations about).—Lumbar colotomy; for strangulated hernia; for peritonitis; for obstruction.

Abscess.—Opening abscess in left leg; opening abscess in neck; puncturing pelvic abscess; abscess in thigh.

Arteries (operations on).—Wound of.

Bone (removal of).—For necrosis.

Breast (operation on).

Chest (operations about).—For empyema; for pleuritic effusion.

Dislocations (reduction of).—Shoulder.

Eye (operations about).—Cataract; opacity of cornea; iridectomy.

Fingers (operations on).—Middle finger of right hand.

Foot (operations on).—Correcting deformity of foot.

Fractures (reduction of).—Position of fracture not stated.

Genito-Urinary Tract (operations about).—Relief of over-distended bladder; sounding for calculus; removal of urethral polypus; rupture of urethra.

Gynaecological Operations.—Incisions of os uteri for dysmenorrhœa; operation on fibrous tumour of uterus; puncture of uterine fibroid; removal of fibroid polypus uteri; removal of intra-uterine fibroid.

Hip (operations about).—Injury to hip; fibrous ankylosis.

Jaws (operations about).—On cancerous gland under jaw; excision of superior maxilla; removal of part of upper jaw-bone for caries; removal of tumour of lower jaw; removal of upper maxillary bone.

[See also Mouth and Throat Operations.]

Joints (excision of).—Knee joint.

Mouth and Throat Operations.—Excision of tonsil; removal of teeth for cancerous growth in gums and throat; small operation in mouth; ? on throat.

[See also Operations on Tongue.]

Neck (operations on).—Bronchocele.

Perineorrhaphy.

Rectum (operations about).—Piles.

Teeth (extraction of).

Tongue (operations on).—Removal of part of tongue for cancer.

Tracheotomy, for diphtheria.

Tumours (removal of).—Axillary tumour; large tumour on chest; sebaceous cystic tumours on head; tumours on neck; tumours in side.

MORE THAN ONE OPERATION UNDERTAKEN AT THE SAME TIME.

For abscess of right thigh with necrosis of femur; extraction of four teeth and removal of upper jawbone for caries; removal of urethral polypus and two sebaceous cystic tumours on head.

SMASHES (OPERATIONS FOR).

For crushing of right hand, compound fracture of fore-arm, simple fracture of humerus and fracture of third rib.

EXAMINATIONS.

In case of diseased hip-joint; in case of strangulated hernia.

Operation not begun when death took place.

METHOD OF ADMINISTRATION.

The methods resorted to were:

I. Without an inhaler. (a) on a handkerchief; (b) on a sponge; placed in a cone extemporised by folding a towel; placed in a bladder. (c) In a cone; in an extemporised cone made with a roll of lint covered with oil silk.

II. With an inhaler. Squibb's inhaler. Allis' inhaler. Clover's larger inhaler. Clover's smaller inhaler. Ormsby's inhaler. Inhaler, "cage."

III. Etherisation per rectum (a small bottle used).

The use of an inhaler in the administration of ether is practically universal, the cone, whether formally constructed or extemporised, being very commonly employed in the United States, and Clover's or Ormsby's inhalers being most commonly had resort to in the United Kingdom when ether is employed. It is important to emphasise this fact, because whereas in the case of chloroform very many persons regard the use of an inhaler as less safe than that of a folded towel or linen cap, and others deprecate the employment of anything except an inhaler: in the case of ether there is a consensus of opinion that that anæsthetic can only be satisfactorily administered when some apparatus, whether a single cone or something more complex is employed.

MEASURES USED FOR RESUSCITATION.

The measures adopted for resuscitation from ether toxæmia are very various, and for convenience have been arranged under separate heads and in alphabetical order. It should be understood in each case various measures were employed, so that the frequency of their employment cannot be accepted as proving whether any particular restorative measures were more valuable than others.

Air: admission of fresh air into room.

Artificial respiration: no method particularised, 20; Silvester's method.

Catheter passed down trachea after performance of tracheotomy and then artificial respiration.

Counter irritation: mustard to calves of legs.

Electricity: "battery," method not specified; faradism; galvanism.

Inversion.—Partial; Nélaton's method of complete inversion.

Laryngotomy.

Stimulants.—No kind particularised.

External.—Cold affusions; rubbing with brandy; slapping with wet towel.

Hypodermic.—Solution of ammonia; solution of ammonia injected into jugular vein; brandy; brandy and water; digitalis; ether; ether and brandy; nuxvomica; sulphate of atropine.

Internal.—Ammonia to nostrils; brandy; brandy per rectum; nitrite of amyl to nostrils; nitrite of amyl and ammonia to nostrils; nitrite of amyl and 3 drops of nitro-glycerine to nostrils; turpentine per rectum; water with vinegar; whisky.

Tongue, drawing forward.

Tracheotomy.

Tube inserted for artificial respiration after performance of tracheotomy.

Measures for resuscitation used but no particulars of them given, 16.

No record of measures for resuscitation, 27.

NECROPSIES IN ETHER TOXÆMIA.

The special points of interest in reviewing the results of necropsies appear to be those revealing evidence of disease, which, if it had been known before the administration of the drug, would have induced the use of chloroform or of some other agent instead; whether the morbid conditions accompanying ether-death are frequent enough to point strongly to the discontinuance of its use when the disease is known to exist during life. Naturally the circulatory, the respiratory, and the renal systems offer special claims for careful study. In seventeen cases we note some more or less pronounced cardiac lesion, but as a rule this is found associated with respiratory trouble, and this suggests the probability of the lung disease reacting upon the diseased heart and so giving the *coup de grâce*. Of the twenty-two cases of lung disease noted only seven seem at all acute, while emphysema and old pleuritic adhesions are frequently mentioned. The great frequency of such post-mortem appearances in all hospital patients who are examined after death must in this connexion be borne in mind. The kidney lesions noted are few, and of these the very large majority, if not all, appear to have been the result of a chronic process. In connexion with this association of chronic lung and chronic kidney disease with ether-death, the interesting inquiry arises how far the reduced action of the excretories prejudices the chances of recovery from the volatile anæsthetics the elimination of which from the blood and the tissues generally must depend upon the activity of the physiological processes of those organs whose function it is to rid the organism of harmful substances. A further point which we may note before passing to the records of the actual cases of the deaths under ether is that in six cases—one female, five males—an anæsthetic had been taken safely on previous occasions. We now append a brief summary of the necropsies of the actual cases.

POST-MORTEM APPEARANCES NOTED IN ETHER TOXÆMIA.

- 1.—External covering of fat over the heart. Lungs slightly congested.
- 2.—Lungs: tubercle in left pleura.
- 3.—Brain: cyst connected with old hemorrhagic clot. Granular contracted kidneys; calculus in pelvis of kidney on right side.
- 4.—Muscular structure of heart flabby. Lungs congested and bright red.
- 5.—Fat round heart: right auricle collapsed; walls of both ventricles thin; endocardium very red; membrane of aorta red. Clot of blood in trachea.
- 6.—Brain: hæmorrhage under arachnoid on upper surface of middle portion of left hemisphere; extravasations of vessels of left hemisphere; large clot in right lateral ventricle; corpus striatum and optic thalamus softened and broken down; small hæmorrhage in left lateral ventricle; atheromatous degeneration of vessels at base of brain.
- 7.—Lungs pale and œdematous. Œdema of membranes of brain.
- 8.—Feeble, flabby heart with fatty degeneration. Lungs emphysematous.
- 9.—Bronchial effusion; pulmonary and serous effusion.
- 10.—Left ventricle of heart slightly contracted. Fæcal staining of œsophagus and larynx. Kidneys slightly granular.
- 11.—Valvular lesions of heart. Arachnoid membrane of brain thickened; effusion of serum beneath it. Cystic degeneration of kidneys.
- 12.—Heart slightly fatty; cavities nearly empty. Lungs emphysematous; posterior parts gorged with blood.
- 13.—Right side of heart dilated, containing post-mortem clots; concentric hypertrophy of left ventricle, which was contracted and contained post-mortem clot.
- 14.—Heart dilated; slight hypertrophy; little fluid clot. Pleura covering left lung thick. Kidneys granular.
- 15.—Cancerous deposits in lungs.
- 16.—Pus in pleura; fistulous communications between bronchi and pleural cavity.
- 17.—Lungs deeply congested. One kidney slightly fatty.
- 18.—Small black mass inside pericardium at root of aorta. Right kidney contained a cyst.
- 19.—Heart fatty; white clot extending from right auricle into pulmonary artery. Cancerous pleuritis.
- 20.—Decolourised clot in right ventricle of heart; black clot and fluid blood in ventricular cavity. Calibre of trachea somewhat diminished by projection of goitre backwards.
- 21.—Heart enormously hypertrophied (31 oz.); mitral valve ossified with calcareous plates at base; aortic semilunar valves also ossified about base. Left lung œdematous.
- 22.—Heart flaccid; right ventricle and auricle occupied by soft coagulum; great increase of fat on surface of same, and very little muscular tissue; valves slightly thickened; pericardium adherent. Lungs emphysematous and congested. Bronchitis with quantity of mucus in tubes; in lower lobes not much air, in upper parts more œdema. Trachea congested, with frothy secretion.
- 23.—Fibrinous clot in right ventricle attached to tricuspid valve.
- 24.—Dense infiltration of entire right lung; lobar pneumonia of right lung in state of bloody engorgement.
- 25.—Fatty heart.
- 26.—Pulmonary emphysema; chronic bronchitis. Chronic nephritis.
- 27.—Lungs collapsed. Long-standing and inflammatory disease in brain and medulla oblongata.
- 28.—Cystic degeneration of kidneys.
- 29.—Kidneys contracted and granular.
- 30.—Heart hypertrophied; pericardium everywhere adherent; coronary arteries of small calibre; slight atheroma of aorta; mitral valve stenotic. Lungs: left pleura, few adhesions; right pleura, many adhesions. Kidneys: left atrophied, capsule adherent, markings indistinct, sclerosis above pyramids, pelvis filled with fat; right same; both surrounded with fat.
- 31.—Heart covered with fat, especially about apex; right side dilated and full of blood; left empty and contracted; walls of right ventricle thin; fatty degeneration. Old adhesions in right pleural cavity.
- 32.—Wedge of meat had been driven into and become fixed in trachea, occluding both bronchi.
- 33.—Heart flabby. Lungs much engorged.
- 34.—Myocardium very fatty; straw-coloured clot in right ventricle and pulmonary artery. Both lungs very emphysematous and the seat of chronic bronchitis.
- 35.—Trachea greatly narrowed from the pressure of an enlarged thyroid body.
- 36.—Pneumonia.
- 37.—Pulmonary œdema.

SERIES A, B, AND C.—CASES OF DEATHS OCCURRING UNDER ETHER.

Series A.—In this series, that collected by the Committee of the Royal Medico-Chirurgical Society, no ether cases were recorded. Snow,² writing before 1858, says he had heard of only two deaths from ether, neither of which could be reasonably put down as having had any relation with it. Under these circumstances the ether cases recorded below have all been grouped in Series B and C, but Series B includes all cases of ether death recorded from the earliest date of its use.

Series B and C.

- 1.—Male, aged 55. In examination of hip-joint after being thrown out of vehicle. Ether given on handkerchief, 4 oz. used. After ten minutes' inhalation patient vomited twice, then became very weak and perspired profusely. Rallied and ether inhaled for ten minutes more. Examination of limb undertaken, but the patient seemed conscious and screamed. His lips became purple and his breath panting. Patient was then given water with vinegar, and subsequently whisky, but he drank very little. Seemed choking. Water was then thrown on his face, and powerful means for resuscitating him employed for 20 minutes. Death imputed to inhalation of ether, but also ascribed to extreme nervous susceptibility. The patient was clearly not completely under the influence of the ether. In this case the method was a bad one, and the effect of shock upon a diseased system was in no way obviated by the imperfect anaesthesia. Post-mortem: Ilium fractured in several places; heart normal, except for external covering of fat; lungs highly congested. Patient corpulent and a hard drinker.
- 2.—Male, aged 55. Died instantaneously after inhalation.
- 3.—The recorder of these cases says: "Decided cases of death from inhaling ether."
- 5.—Female. Respiration failed before the pulse. Voluntary respiration ceased, countenance became livid, pulse rapid; was carried to a window, but at end of 20 minutes was dead.
- 6-7.—No particulars.
- 8-15.—No particulars.
- 16.—No particulars.
- 17.—Without hæmorrhage, but extreme muscular relaxation, coma, exhaustion, intermittent pulse.
- 18.—Female, aged 40. Removal of urethral polypus and two sebaceous cystic tumours on head. 30 grammes (under 1 oz. of ether used). Anaesthesia incomplete; ether not pushed further, because stage of excitement did not come on, and coldness and slowness of pulse were present. When operation completed, coldness increased, with clammy sweats, convulsions, and foaming at mouth. Attack passed away, but soon returned—more intense. After fourth attack patient died from eclampsia, attributed to etherisation. Had previously been subject to epileptic vertigo.
- 19.—Female, aged 48.—Correcting deformity of foot. Pulse and respiration failed together. Breathing failed, face pale, pulse ceased; revived once, but relapsed and died. Syncope from general debility. Post-mortem: Tubercle in left pleura, spinal cord, and hip-joint. Patient of delicate constitution. Ether employed of more than 62 degrees; contained no foreign substance save 3 per cent. of water.
- 20.—For excision of superior maxilla. Respiration failed first. Early in operation respiration ceased, and patient died, in spite of all efforts at resuscitation. Death probably only partially influenced by ether.
- 21.—Male, aged 70. Reduction of fracture. Respiration failed first. Breathing became feeble and irregular; etherisation suspended. In 4 or 5 minutes respiration and pulse became better. Ether re-administered; bad symptoms returned, and pupils became dilated. Heart still beating, but attempts to resuscitate of no avail. Patient suffering from fracture near trochanter of 18 days' duration, and from pneumonia.
- 22.—Male, aged 84. On cancerous gland under jaw. Underwent operation quite satisfactorily, with no failure of pulse, the carotid artery (left side) having been compressed. He went to bed and never became actually conscious, though was able to leave bed to pass urine; sank into state of coma; was treated with mustard plasters on calves of legs and enema of turpentine. Could not swallow food, and was fed by stomach tube. Had several convulsive seizures. Died 40 hours after operation with cerebral symptoms, but post-mortem revealed no lesion of brain whatever, except cyst connected with old hæmorrhagic clot on right side, whereas the spasmodic seizures he suffered from were on left side of face. Kidneys both granular, right more so; latter small and contracted; in its pelvis a calculus with moulded conical projections on one side. Chest not examined, but no symptoms from heart or

² *Anæsthetics*, p. 362.

- lungs. Death probably due to excitement of ether on a senile and degenerate brain. Had taken chloroform very well for similar operation four months previously.
- 23.—Male, old. Respiration failed first. Had undergone operation, which lasted about $\frac{1}{2}$ hour; 5 hours later bad violent attack of dyspnoea and died. Weak, but not excessively so.
- 24.—No particulars given.
- 25.—Male, aged 16. Slight operation. Amyl hydride and anhydrous ether, 4 dr. [? ether for local anaesthesia]. ? Pulse failed first. After administration commenced alarming symptoms followed. Galvanic battery and artificial respiration without result; also Nélaton's method of suspension by feet. Syncope. Post-mortem: Organs healthy, except that spleen showed commencing amyloid degeneration. Had taken chloroform for similar operation twice before; first time well; on second occasion alarming symptoms appeared.
- 26.—Male, aged 51. Removal of part of tongue for cancer. Ether (hint cone covered with oil-silk). Respiration failed first. Face became dusky; pulse still good, but respiration shallow with effort to expel blood. Screw gag (for operation) removed, tongue pulled out, and artificial respiration (Silvester's method). Breathing ceased, though pulse kept beating some minutes. Persistence in restorative measures for $\frac{1}{2}$ hour. Asphyxia; blood escaped into glottis during artificial respiration. Post-mortem: Lungs very inflated, greyish. Fat round heart; right auricle collapsed, containing little frothy blood. No blood in right ventricle; walls of both thin, valves healthy. Ounce of fluid blood in pulmonary artery. Only 2 fluid dr. of blood in the left side of heart; valves healthy. Endocardium extremely red. Aorta contained a little dark blood, its endothelium red. In the trachea was a clot of blood extending from glottis into trachea 4 in. by $\frac{1}{2}$ in. in dimension. Thin and slightly pallid; otherwise looked healthy. This is a case which perhaps belongs more to the class of remote deaths, as the asphyxia, which was the cause of death, was directly due to hemorrhage.
- 27.—Male, aged 69. For strangulated hernia of 3 days' standing (Clover's inhaler) 2 dr. used. Pulse failed first. Respiration continued for short time; pulse became weaker, and finally stopped. Silvester's artificial respiration and other methods tried, but failed. Collapse from shock. A death due more to shock than to ether.
- 28.—Female, elderly. Removal of axillary tumour (about 40 minutes); $\frac{1}{2}$ oz. used. Pulse failed first. Pulse in radial and temporal arteries ceased. Hypodermic injections of brandy and water given. Patient revived, and operation proceeded with. No more ether given. Patient vomited, sank, and did not recover. Head was lowered, and 4 oz. of brandy and water given per rectum, also spirits of ammonia (1 dr.). Collapse from shock.
- 29.—Female, aged 48. Removal of cancer of breast. Pulse failed first. After a few inhalations patient's face suddenly became turgid, and hands white. Inhaler removed, tongue brought forward, cold water dashed over face and chest; rubbed with brandy; but breathing more stertorous; face more congested; pulse failed; effort at vomiting; death. Emphysematous state of lungs prevented passage of blood through pulmonary vessels. Right side of heart overcharged with blood, and being degenerated, could not discharge its contents. Post-mortem: Heart feeble and flabby, with fatty degeneration. Liver firm, but whole of upper surface attached by old adhesions to nuder surface of diaphragm; air cells of lungs dilated; valves of heart healthy. Death also attributed to failure of heart's action and impairment of functions of diaphragm through its attachment to liver. Patient somewhat nervous, though quite cheerful before operation.
- 30.—Female. Incision of os uteri for dysmenorrhoea. On towel. Pulse and respiration failed simultaneously. Breathing and pulse failed, and patient could not be resuscitated.
- 31.—Male, aged 74. For cataract. $\frac{1}{2}$ lb. used. Coughing, then lividity and cessation of breathing. Resuscitative measures taken, and respiration restored; lividity partly disappeared, and heart's action became stronger. Operation was concluded. Again respiration ceased, lividity increased, and pulse became very weak, death ensuing in spite of all efforts to prevent it.
- 32.—Male, aged 50. Examination for strangulated hernia. $\frac{1}{2}$ oz. used. Respiration failed first. Sudden spasmodic inspiratory sound heard, as if choking. Tongue drawn forward, but respiration had ceased, though pulse beat for another $\frac{1}{2}$ minute. Silvester's method of artificial respiration employed, during which some fecal matter came up into mouth. These efforts made for $\frac{1}{2}$ hour, but proved useless. Many circumstances predisposing death, besides administration of ether; strangulation had existed 4 days, with constant vomiting and enfeebled circulation. Post-mortem: Heart, left ventricle contracted; otherwise healthy. Lungs congested. Fecal staining of oesophagus and larynx, but no fecal matter had entered lungs. Kidneys slightly granular.
- 33.—Male, aged 55. For injury to hip. Sulphuric ether used. Respiration failed first. After taking ether for 15 minutes patient, without warning, ceased to breathe. Artificial respiration used without success. Post-mortem: Effusion of serum beneath arachnoid, with thickening of that membrane. Valvular lesions of heart. Cystic degeneration of kidneys.
- 34.—Female. Extraction of tooth. Not quite 1 oz. used. "Paralysis of heart."
- 35.—Male, aged 66. Opening bowel in right lumbar region for obstruction (10 minutes). 1 oz. used in Clover's smaller inhaler. Patient showed inclination to vomit, and ejected quantity of brownish fluid, smelling strongly of brandy. Took one deep inspiration; seemed inclined to vomit again; sank back, and died. Artificial respiration and other means employed; result only one short gasp. No post-mortem. Much difficulty in ascertaining real cause of death. There was no obstruction to respiration by regurgitation of vomit into larynx. (1) Distention of bowel may have interfered with descent of diaphragm, and so hindered respiration; (2) assthesia, owing to abdominal obstruction. Lungs having been emptied of air through vomiting, quantity of blood drawn into heart and vessels by next respiration may have brought feeble heart to standstill; (3) "Ether might have been mixed with vomit containing brandy, which would increase narcotising power, and increase cardiac depression." For some weeks had had symptoms which ended in complete obstruction of bowel, either in lower bowel of descending colon or in sigmoid flexure.
- 36.—Female, aged 43. Amputation for abscess in right thigh, with necrosis of femur. Ether on sponge, placed on towel formed into cone. Respiration failed first. An incision had been made down to the femur, when the respiration and pulse were noticed to have stopped. Artificial respiration, brandy per rectum, and nitrite of amyl, and carbonate of ammonia applied, partially restored respiration and pulse; but very shortly the pulse began to flicker, and then gradually failed. Artificial respiration, galvanism, and injection of 5 minims of ammonia into jugular vein also unsuccessfully tried. Post-mortem: The lungs were not materially affected, and the heart was normal. Her condition was bad. Broken down by continued suffering, emaciated, unable to take food, and frequently vomiting. The abscess followed delivery, and was associated with necrosis of part of the femur.
- 37.—Male, aged 53. Removal of large tumour on chest. $2\frac{1}{2}$ oz. used in Clover's smaller inhaler. Pulse failed first. Livid pallor overspread face of patient; breathing undisturbed; but pulse became faint, and at last imperceptible. Brandy, lowering of head, &c., tried with no effect. Drew last breath 10 or 12 minutes after completion of operation. Syncope from surgical shock. ? Post-mortem. The operation had been severe.
- 38.—Male, aged 61. For strangulated inguinal hernia. Pulse failed first. Pulse became imperceptible, and finally respiration ceased. ? Syncope from shock. Post-mortem: Heart substance slightly fatty; cavities nearly empty; no clots. Lungs emphysematous, posterior parts gorged with blood. Had been delirious during preceding night. Pulse irregular and very feeble, and he had constant vomiting.
- 39.—Male, aged 47. Lumbar colotomy for intestinal obstruction. Clover's smaller inhaler. After inhaling ether for 10 minutes became livid, and never rallied. Before taking anaesthetic was in state of profound collapse; belly tumid, respiration shallow, pulse feeble. ? Syncope from shock. Post-mortem 2 hours after death: Effects of former catarrhal pneumonia observed. Right side of heart dilated, containing post-mortem clots. Concentric hypertrophy of left ventricle, which was contracted. Post-mortem clot. No fatty degeneration.
- 40.—Female, aged 26. For fibrous ankylosis of hip. 2-3 oz. used. Operation concluded, but patient did not rally from anaesthetic, and, in spite of stimulants, died $\frac{1}{2}$ hours after etherisation. ? Shock. Post-mortem appearances *nil*.
- 41.—Male, aged 55. Ruptured urethra. "Ether pneumonia." Post-mortem made; details not given.
- 42.—Female, aged 6. Tracheotomy for diphtheria. 1 oz. on cage inhaler. Respiration failed first. Before operation was begun breathing suddenly ceased. Artificial respiration at once tried; patient gave one gasp; artificial respiration prolonged, but useless. Heart beat feebly 2 minutes after breathing failed. Failure of respiration, when respiratory powers already overtaxed by laryngeal diphtheria. Patient somewhat mentally deficient, and of delicate habit.
- 43.—Male, aged 45. Reduction of hernia (inguinal). Pulse and respiration failed together. Pulse and respiration suddenly ceased. Prompt and active efforts, but no return to vitality. Syncope. Post-mortem: Kidneys granular, contracted. Heart dilated, slight hypertrophy, little fluid clot. Pleura covering left lung thick. Capsules of liver and spleen thick and opaque.
- 44.—Female, aged 50. Removal of tumour from lower jaw. Respiration failed first. Patient's breathing became embarrassed; she seemed to suffer from shock consequent on operation. All usual means to restore life failed. Asphyxia; for at post-mortem, cancerous deposits found in liver and lungs, deposit in lung accounting for difficulty of respiration. Patient's condition as revealed by post-mortem not foreseen, or operation would not have been attempted.
- 45.—Male, aged 48. On middle finger of right hand. Respiration failed first. Before patient fully anaesthetised he suddenly ceased to breathe. Artificial respiration used without avail. "Death from syncope" (verdict at inquest); but far more probable death commenced from lungs, and was caused by asphyxia. Patient, miller by trade, and emphysematous, and so easily affected by ether.
- 46.—Female, aged 50. Removal of sloughing fibroid polypus uteri (1 hour 25 min.). Respiration failed first. During operation, heart weak, and required brandy three or four times to rally its power. Five minutes after operation patient suddenly gasped, and ceased breathing, carotid pulse still beating firmly. Measures employed were artificial respiration and galvanism, also holding head downwards, but gush of blood from mouth and nose prevented this. Amyl nitrite to nose, and three drops of solution of nitro-glycerine (1 per cent.); heart ceased about 1 minute after respiration, artificial respiration for 15 minutes, but no signs of life. No signs of asphyxia, face being pallid, lips blanched, and jugulars not over distended. Syncope most probable cause, though respiration ceased first. Patient was suffering from blood-poisoning due to absorption of septic products from decomposing polypus. Although much exhausted, and suffering from mitral valvular disease, it was thought right to give chance of recovery afforded by operation.

- 47.—Male, aged 53. For crush of right hand, compound fracture of forearm, simple fracture of humerus, and fracture of third rib. Respiration failed first. Took anæsthetic badly, breathing feebly and struggling. When operation nearly completed, breathing suddenly ceased. After artificial respiration for 15 minutes patient began to breathe and feeble femoral pulse could be felt, but this soon ceased. ? Syncope or shock. Post-mortem: All organs healthy, except that right kidney contained a cyst, and that there was a "small black mass" inside pericardium at root of aorta. The severe accident a great shock to the central nervous system. Patient could hardly be said to be healthy, though his organs showed no gross disease.
- 48.—Male, aged 12. Excision of knee-joint. Nearly 1 lb. Pulse and respiration failed together. After operation was completed breathing became faint, and pulse disappeared at wrist. Measures adopted were artificial respiration, hypodermics of ether, brandy, and ammonia, faradisation of diaphragm and slapping extremities. These efforts continued for 45 minutes. There had been no vomiting. Syncope. Post-mortem: All internal organs intensely congested. Heart empty, having stopped in systole. No mucus in larynx. Patient healthy except for disease of knee. Ether used was Power's and Weightman's.
- 49.—Female. For strangulated umbilical hernia. Pulse and respiration failed together. Had fit of vomiting. Heart's action ceased, also respiration; tracheotomy performed and trachea sucked out, but life was extinct. ? Asphyxia or cardiac paralysis. Had weak heart at beginning of operation.
- 50.—For wounded artery. Pulse failed first. Wounded vessel was exposed, and pulse became imperceptible directly incision was made in skin. Operation suspended, some restorative given, pulse again felt, and operation continued. Pulse stopped second time, respiration ceased, and all attempts at resuscitation useless. Cardiac paralysis, from excessive action of ether upon heart, enfeebled from loss of blood. Death, perhaps, might have been averted by preliminary transfusion. Stout, healthy man, who, in use of pruning knife, accidentally injured right carotid artery.
- 51.—Old woman. Removal of tumour, upper jaw (patient in sitting posture). Pulse failed first. Face had become somewhat livid from ether, but just after incision made in skin, pulse stopped, and heart's action not resumed. Paralysis of heart.
- 52-53.—Two cases. Removal of tumours of neck. ? Respiration. Considerable embarrassment of respiration. No blood or vomited matter to account for death.
- 34.—Male. Reduction of double incarcerated scrotal hernia. Contents of hernia forced up into abdomen, and patient ceased to breathe. Post-mortem showed nothing to account for death, cause of death being attributed to fact that abdomen was compelled to received more than it was accustomed to, and thus action of diaphragm interfered with. A very doubtful case as far as the anæsthetic is concerned.
- 55.—Male, aged 50. For removal of teeth for cancerous growth in gums and throat. Pulse and respiration failed together. One tooth had been removed when breathing became bad and pulse failed. Artificial respiration employed without success, and every means likely to restore animation used. Syncope. No sign of disease in heart or lungs to forbid use of ether. Had been an habitual smoker. "Saliva swallowed of poisonous nature." Was weak from the exhausting nature of malady.
- 56.—Female, aged 43. On fibrous tumour of uterus. Ether given in cone. Respiration failed first. Great care taken in administration, as patient was weak from previous hæmorrhage. Patient had large goitre which became larger during inhalation. Whistling sound noticed in breathing. Just before operating, breathing ceased, face very livid. Pulse regular. Tongue pulled forward and artificial respiration. Silvester's method used, as breathing did not return; tracheotomy performed and large tube inserted for artificial respiration. This was successful for a short time, but eventually failed. A catheter was passed down the tracheal tube to inflate lungs, but in vain. Pulse was regular for some long time, but at last ceased. "Epileptiform spasm of respiratory muscles" induced probably by fright and causing asphyxia. Post-mortem: calibre of trachea somewhat diminished by projection of goitre backwards. Lungs: no pleural adhesions, pale; structure normal. Heart healthy, decolourised clot in right ventricle, black clot and fluid blood in ventricular cavity. Other organs healthy except uterus. Patient had lost a good deal of blood and was becoming weaker.
- 57.—Female, aged 62. Exploratory puncture of uterine fibroid. "Syncope under ether." Hæmorrhage into peritoneal cavity.
- 58.—Relief of inguinal hernia. Respiration failed first. Became cyanotic and respiration ceased; 5 minutes after breathing stopped, pulse 76 and strong. Tongue pulled forward and artificial respiration employed, with no avail. Post-mortem: No air in heart, in great vessels of trunk or large vessels of brain. Aorta and branches atheromatous and calcified. Abdominal aorta with large calcareous plate. Ophthalmic artery twice usual size and atheromatous. Heart enormously hypertrophied, weighing 31 ozs. Left ventricle thickened; mitral valve ossified, with calcareous plates at base. Aortic semi-lunar valves also ossified about base. Aortic orifice might well have been closed by valves, but mitral could not. Left lung oedematous.
- 59.—No particulars.
- 60.—Boy. For bronchocele. No particulars.
- 61.—Male, aged 62. Reduction of dislocation of shoulder. Ormsby's inhaler. Pulse failed first. After the operation the reduction was found not satisfactory. To complete it, the inhaler was replaced on the patient's face without any fresh ether in it. After completion and removal of bag, pallor and feeble breathing came on. Measures used were the hypodermic injection of brandy, artificial respiration, drawing forwards of tongue, and battery. Death from fatty heart combined with bronchitis and emphysema. Post-mortem: Lungs emphysematous and congested; bronchitis with quantity of mucus in tubes; in lower lobes not much air, in upper part more oedema; trachea congested with frothy secretion. Heart flaccid, right ventricle and auricle occupied by soft coagulum, great increase of fat on surface of same and very little muscular tissue, which at apex had nearly disappeared, valves slightly thickened, pericardium adherent. Death thought to be caused by "shock of reduction during semi-narcosis." (See THE LANCET, Feb. 14, 1885, p. 316.)
- 62.—Female, aged 20. For opening empyema for drainage. 2 oz. used. Pallor and unsatisfactory breathing. Patient was laid down; pulse at wrist imperceptible. Ammonia applied to nostrils and prolonged efforts at artificial respiration of no avail. Syncope caused by (1) patient sitting up for operation; (2) nausea, and therefore cardiac depression, due to incomplete anæsthesia; (3) shock by introduction of needle.
- 63.—Female, aged 40. For pyæmia, abscess in knee-joint and pelvis. $\frac{1}{2}$ oz. used. Respiration failed first. Respiration suddenly ceased. Immediate and vigorous attempts taken to restore breathing by artificial means, but no recovery. Syncope.
- 64.—Male, aged 58. Empyema (17 minutes). Pulse and respiration failed together. For first 17 minutes breathed well. Ether then discontinued. About 15 minutes later pulse and breathing began to fail. Seemed to die from a kind of syncope. ? Syncope. No post-mortem allowed.
- 65.—Female, aged 10. Sounding bladder. Pulse failed first. After a few inhalations was observed to be very pale. Pulse ceased, breathing continued. Artificial respiration, galvanism, injections of brandy tried in vain. No post-mortem. Much emaciated. Seemed to be suffering from tubercular disease of kidney.
- 66.—Female. Extraction of tooth. After operation partly recovered, but then lapsed into unconsciousness and died.
- 67.—Female, aged 50. For perineorrhaphy. Immediately after operation pneumonia set in, to which patient succumbed. Pneumonia. Post-mortem: Fatty heart, pulmonary emphysema, chronic bronchitis with chronic nephritis.
- 68.—Male, adult. Small operation in mouth. No particulars.
- 69.—For hæmorrhoids. Respiration failed first; stopped suddenly. Heart continued beating some time after respiration ceased (3 hour). Cerebral embolism, shock of operation, or excessive apprehension. Post-mortem: Long standing and inflammatory disease in brain and medulla oblongata. Lungs collapsed.
- 70.—For abscess in neck. Post-mortem: Kidneys diseased through cystic degeneration.
- 71.—Male, aged 46. Syme's amputation of tuberculous ankle (about 10 minutes). Ether (administered after $\frac{1}{2}$ oz. whisky had been given). Respiration failed first. In a few minutes respiration faltered, patient became cyanosed deeply, but this passed away. In another 5 minutes pulse ceased. Measures adopted for resuscitation were: hypodermics of brandy, ether, and sulphate of atropine, application of nitrite of amyl to nostrils, artificial respiration, depression of head and shoulders—with no effect. Syncope. Post-mortem: No rigor mortis; body well nourished. Lungs small; left pleura, few adhesions; right pleura, many adhesions. Heart hypertrophied, pericardium everywhere adherent, coronary arteries of small calibre, slight atheroma of aorta, mitral valve stenotic, and spleen enlarged. Kidneys: left atrophied, capsule adherent; markings indistinct; sclerosis above pyramids; pelvis filled with fat. Right kidney same, both surrounded by thick layer of fat. Most striking revelation was complete adherence of both surfaces of pericardium; the heart was so fettered that it could not respond to the unusual strain thrown upon it. Was suffering from tuberculous disease of tarsus of one foot. General appearance of patient bad. Aortic and mitral systolic murmurs, and heart sounds feeble. Urine contained moderate amount of albumen. Patient very nervous. Rather more struggling than usual, which closely preceded failure of pulse. Heart in condition to suffer permanent arrest of function upon any strain; and any mental or physical excitement would have been too much for it. "If more than ordinary care had been exercised to quiet patient's nervousness, the feeble heart might have emerged from its ordeal." Squibb's ether fortior used.
- 72.—Male. On throat. Patient was suffering from cystic degeneration of kidneys.
- 73.—Male, aged 8. "Caseous glands. Oedema." Ether. Pulmonary complications. Post-mortem made, but no particulars given.
- 74.—Male, aged 20. Scraping away granulations and opening sinuses in abscess of left leg. Clover's inhaler used. Pulse probably failed first. During operation, after breathing normally several times, deceased moaned, turned pale, ceased breathing. At same time pupils dilated. Tongue drawn out with forceps, and artificial respiration begun. Chest slapped with wet towel. Hypodermic of ether and brandy. Battery applied, and artificial respiration kept up $\frac{1}{2}$ hour. All these measures were without avail. Syncope; not failure of respiration. Post-mortem: Layer of fat over chest; muscles paler than natural. Lungs healthy, but some old adhesions in right pleural cavity. Heart covered with fat, especially at apex, right side dilated and full of blood, left empty and contracted, walls of right ventricle thin, valves healthy, heart muscle pale and soft, microscopically showing fatty degeneration. Patient stout, flabby, rather anæmic. Had been always healthy before suffering from abscess, which was chronic. After admission to hospital two other abscesses opened; one under chloroform, other under nitrous oxide. Passed through both operations successfully.

- 75.—Female, aged 44. For cancer. Pulse failed first. Sudden stoppage of pulse. Every means of artificial respiration tried, but death took place in less than a minute. Operation not begun. Patient not completely anaesthetised. Syncope. Heart examined prior to administration and found to be sound.
- 76.—Male, aged 46. For relief of over-distended bladder. Clover's inhaler. Pulse failed first. Before operation commenced pulse suddenly became very feeble, hardly perceptible at wrist; lips pale, breathing gasping, pupils normal. Measures resorted to were: Drawing out tongue, stimulation of cardiac area and chest, artificial respiration for $\frac{1}{2}$ hour; but pallor increased, and death took place. ? Syncope. No post-mortem allowed. Hard drinker. Had had tight stricture of urethra for 8 months, and had refused treatment. Heart hypertrophied, double aortic and mitral murmurs could be heard. Pulse feeble and irregular. Chest barrel-shaped from emphysema. Bladder enormously dilated, and urine dribbling away. Penis and scrotum swollen, and almost gangrenous from extravasation. Would have no operation without anaesthetic.
- 77.—Female, aged 41. Removal of intra-uterine fibroid ($\frac{1}{2}$ hour). Pulse probably failed first. 25 minutes after anaesthetisation it was noticed that the heart was acting feebly. About 5 minutes later death supervened. Artificial respiration maintained for 1 hour, a few weak respiratory efforts made after heart stopped. Hypodermic of tincture of digitalis (10 minims) and nux vomica (10 minims) also given. Heart failure. Patient was very anæmic, but heart, lungs, and kidneys were in good condition. Had had ether twice before for similar operations. One teaspoonful of aromatic spirit of ammonia and a table-spoonful of brandy were given $\frac{1}{2}$ hour before anaesthetisation.
- 78.—Male, aged 50. For tumour in side. Heart examined before administration and nothing abnormal detected.
- 79.—Male, aged 56. Reduction of fracture of tibia and fibula. Pulse failed first. After operation had been successfully performed, heart suddenly ceased beating, then respiration stopped and patient died. Heart ceased beating 3 minutes after cessation of administration of ether. ? Syncope. Post-mortem: Lungs much engorged; flabby heart and fatty liver. Was a drunkard. After admission on account of fracture, suffered from delirium tremens for 10 days. Operation then undertaken.

DEATHS REMOTELY DUE TO THE ADMINISTRATION OF ETHER.

As in the case of chloroform so in that of ether, a certain number of fatalities have occurred while ether was being administered, or after its exhibition, which have been attributed to its effects, immediate or remote.

These "remote deaths," as we may term them for the sake of brevity, have been recorded as of about equal frequency in hospital and private practice. The deceased have been of ages ranging from 8 to 72 years, but most were over 35, and more fatalities have been recorded among women than men.

Records have reached us from various parts of England, from France and Spain, but most instances come from the United States, where this anæsthetic is used perhaps more largely than elsewhere.

The pulse appears to have failed either after the cessation of respiration or simultaneously with it, although instances are recorded in which primary failure of circulation is said to have occurred.

OPERATIONS WITH WHICH REMOTE DEATHS WERE ASSOCIATED, ETC.

Amputation of arm, of finger; about abdomen: herniotomy, lumbar colotomy, ovariectomy; extirpation of vaginal glands; for empyema; removal of tumour from upper jaw; plastic operation on upper lip; castration; forcible movement of joints; operations about rectum; removal of teeth. With the possible exceptions of the two operations for the relief of empyema, and of the operations for the removal of the maxillary tumour, none are operations which would be regarded as rendering the use of ether fraught with especial danger or difficulty.

Of Predisposing Causes for such casualties we have but few records. Only one individual is specially mentioned as having been intemperate; pulmonary emphysema is recorded in two cases, and several more cases are mentioned in which bronchial inflammatory conditions of the lungs complicated the operation. Vomiting occurred on three occasions, and was probably the immediate cause of death.

The Causes Assigned for Death were: asphyxia, either simple or mechanical, as in the cases in which masses of food or vomit entered the air passages and produced suffocation; a case in which bronchitis supervened and proved fatal in a week; œdema of the lungs; congestion of lungs; pneumonia; cerebral hæmorrhage; surgical hæmorrhage;

ileo-colitis following rectal etherisation; cardiac syncope (3 weeks after taking the anæsthetic).

The Methods of Administration were: a sponge contained in a folded towel; a sponge in a bladder; Allis's inhaler; Ormsby's inhaler; Squibb's inhaler; an extemporised apparatus for rectal anaesthesia.

The Measures Adopted for Resuscitation were simply the employment of artificial respiration, the adoption of the dorsal decubitus, stimulation of the præcordium by hot water and the internal administration of stimulants.

The Facts Elicited by Post-mortem Examination may be summarised as follows:—Circulatory System, distension of right side of heart; clot in coronary artery (said to have been 3 weeks old); fatty conditions of the heart in 3 cases. Pulmonary System: inflammation, recent in one case; lobar pneumonia; engorgement and inflammation of lungs; foreign bodies in air passages—vomit, food, blood, pus, &c. No renal lesions. In one case cerebral hæmorrhages are noted with extensive atheroma present.

Series A, No cases.

Series B.

- 1.—Male, aged 50. The patient gradually sank and died 4 hours after operation.
- 2-5.—Three males and one female. In each of these cases death occurred 3 hours after operation; but no particulars are given.
- 6.—Female, aged 8. Extraction of teeth (20 minutes). Patient vomited, but ether resumed, when she vomited again. The face became livid; was "black in the face." She was laid on the floor, the tongue drawn forward, and artificial respiration by Marshall Hall's method commenced. She ceased breathing after a few efforts at respiration. Asphyxia was stated to be the cause of death. Post mortem: "Mass of undigested liver firmly impacted in rima glottidis." Was highly nervous. Had no organic disease. Every care used in giving ether, and there was a due admixture of air. Patient had taken no meal for some hours. Ether quite pure.
- 7.—Female, adult. While lying on back under the ether, vomited and some of the vomit getting into trachea killed her, Asphyxia.
- 8.—Female, aged 48. Iridectomy. 2oz. given in Squibb's apparatus. Inhaled ether and passed through operation well. Five minutes after attempted to vomit, and became cyanotic and unconscious, with stertor, and great perspiration. Seemed suffering from cerebral hæmorrhage. Improved 4 hours later, and became conscious, but with hemiplegia of left side, passing urine involuntarily. Next day before midnight symptoms became more serious, and death occurred next morning, 37 hours after operation. Cerebral hæmorrhage following administration of ether. Post mortem: Large hæmorrhagic patch under arachnoid on upper surface of middle portion of left hemisphere. Vessels of left hemisphere much fuller than those of right, with numerous capilliform extravasations. Large clot in right lateral ventricle, corpus striatum and optic thalamus softened and broken down; small hæmorrhage in left lateral ventricle; extensive atheromatous degeneration of vessels at base of brain. No other organs than brain examined. Moderately stout, pale complexion; complaining of no previous sickness.
- 9.—Female, aged 35. For contracted knee. Ether given in Ormsby's inhaler. Passed through operation and etherisation with no untoward results, but $1\frac{1}{2}$ hours later became cyanotic and pulseless with *râles* all over thorax. Symptoms came on at 2.45 P.M.: all attempts to rally fruitless, and patient died at 4.15 same afternoon. Œdema of lungs, though complete recovery from ether narcosis. Post mortem: Œdema of membranes of brain; no thrombosis of pulmonary artery. Heart healthy, with little blood in right auricle. Lungs pale and œdematous. After operation was carried across a court in open air to ward. Whether this exposure was really the determining cause of death could not be decided.
- 10.—Aged 19. (20 minutes.) Operation performed, but death followed 2 hours later. Post mortem: Bronchial mucus, pulmonary and serous effusion found. Had contracted chest, and lungs restricted by adhesions, which bound them down in all directions.
- 11.—Male. Amputation of finger. Vomiting; part of vomited matter went into windpipe and lungs causing suffocation. Windpipe opened and every effort made to save life. Asphyxia.
- 12.—Male. Amputation of arm (more than $\frac{1}{2}$ hour). Respiration failed first. Great difficulty in inducing anaesthesia. Operation very simple and very rapid. All went well till next day, when patient began to cough and respiration was hurried. The asphyxia became progressively marked, and in about a week the man died suffocated. Cause assigned for death: asphyxia. Post mortem: No lesion of any organ except that the lungs were very vascular, red, and inflamed. No hepatisation of lungs. The wound kept the same appearance from the time of operation to death; it did not suppurate nor did it heal; only a little serous fluid trickled from it. The patient was very fat.
- 13.—Male. Amputation of leg above ankle-joint: injured by gunshot wound. Ether given on a sponge in cone of folded towel. Pulse failed first. Operation was being performed when

- patient became cold and pulseless and sweated profusely. Respiration ceased. Measures adopted were: artificial respiration; brandy (some swallowed); clothes wrung out in boiling water to region of heart. Feeble heart sounds could be heard, but all efforts to restore animation failed. Shock, probably, not ether. (1) Shock of gunshot wound. (2) Of entire charge striking one part, thus being equal to a bullet. (3) Of ankle-joint being destroyed. (4) Of operation. Patient probably commenced to die when limb was separated from body.
- 14.—Aged 55. Removal of tumour from upper maxillary bone. Ether given on sponge in bladder. Pulse and respiration failed together. During operation breathing stopped, no pulse at wrist and doubtful whether any at precordial region. Artificial respiration and recumbency of no effect. Haemorrhage (Snow), but doubtful whether cause was not combination of suffocation and haemorrhage.—(See Snow's *Anæsthetics*, p. 364.)
- 15.—Male. For empyema. Respiration failed first. When under influence of ether patient rolled over on to sound side. At once great difficulty of breathing set in, pus welled out of mouth, and patient was suffocated by accumulation of pus in air passages. Asphyxia. Post mortem: Besides pus in pleura, numerous fistulous communications between bronchi and pleural cavity, the pus having found its way from the latter into the former. Ether regarded as bad anæsthetic for empyema because it exercises its lethal influence first on the lungs and causes large accumulation of mucus in throat, and both these conditions unfavourable to patient who has only one lung to lose.
- 16.—Female, aged 54. Reduction of dislocation of shoulder. Ether (Squibb's), 6 oz. used. After operation and return to consciousness—five minutes after operation—patient drank some water; 1½ hours later was found cyanosed and dying. Active stimulating treatment applied, but patient died in another half-hour. Congestion of lungs. Post mortem: One kidney slightly fatty and lungs deeply congested; congestion set up by ether-vapour, and here rapidly fatal. Patient well nourished. Heart and lungs sound.
- 17.—Female, aged 45. For pleural effusion. Respiration failed first. When about a pint of effusion had been withdrawn, face became livid, breathing irregular and gasping. Was revived with difficulty, but seemed to quite recover. Dyspnoea and lividity returned and patient died asphyxiated. Asphyxia from heart clot. Post mortem: Fatty heart, white clot extending from right auricle into pulmonary artery. Cancerous pleuritis and peritonitis. Had taken ether successfully for same operation a month earlier.
- 18.—Female, aged 49. Carcinoma of large intestine. "Asphyxia from vomit in trachea whilst under ether." Post-mortem but no particulars given.
- 19.—Female, aged 64. Ovariectomy. Respiration appeared to fail first. Took anæsthetic well, but 12 hours after had dyspnoea and died with congestion of lungs 17 hours after operation.
- 20.—Male. For anal operation. Ether given, in large quantity. Pulse failed first. Patient took anæsthetic successfully and operation was performed, but three weeks later was found dead in bed, in full rigor mortis. Syncope in cardiac diastole, due to thrombosis of coronary artery. Post mortem: Heart, left side, especially ventricle, much distended with liquid blood; right cavities less loaded; substance of heart soft and flabby. Left coronary artery obstructed by clot of blood, age about three weeks, formed at time of ether administration. Patient active, vigorous, and in good spirits.
- 21.—Male, aged 73. For relief of right inguinal hernia (herniotomy performed). Operation lasted 25 minutes; cause of obstruction, square piece of potato swallowed unmnasticated, patient being toothless. Wound healed, but uræmia, vomiting, and stupor came on, and patient died 10 days later. Uræmia, induced by giving ether, which was the primary cause of death in this and the 3 following cases. No indication of kidney trouble previous to operation. "Ether counter-indicated in all affections impairing integrity of renal function."
- 22.—Female, aged 43. For lumbar colotomy for cancerous stricture of rectum. Operation performed, patient being placed on her right side. Severe chill, high fever, and pneumonia of entire right lung set in, to which patient succumbed 4 days after operation. Colotomy wound had healed throughout by adhesion. Pneumonia was assigned as the cause of death. Post mortem: Dense infiltration of entire right lung. Suffered also from chronic bronchitis. "Chronic catarrhal affections of bronchi of aged, and perhaps of infants, frequently develop into catarrhal pneumonia, terminating in death of the usually enfeebled patients in question."
- 23.—Male, aged 60. Castration of tuberculous testicle. Operation performed; 3 days later chill set in, followed by fever and pneumonia. Wound satisfactory. Pulse fluttering and frequent. Respiration shallow and hurried, patient comatose. Died same day. Pneumonia was assigned as to the cause of death. Post mortem: Lobar pneumonia of right lung in stage of bloody engorgement. How far this case can be considered due to the anæsthetic seems doubtful.
- 24.—Male, aged 61. Inguinal colotomy for far-gone cancer of rectum. 4 days after operation pneumonia set in and traversed left lung. Prostate and neck of bladder involved in cancerous growth, causing frequent and painful micturition, and, finally, cystitis and pyelo-nephritis, to which patient succumbed about 6 weeks after operation. The wound healed. Profuse purulent bronchial secretion noticed up to time of death. Pneumonia complicated with cystitis and pyelo-nephritis.
- 25.—Male, aged 25. Extirpation of inguinal glands. Fatal pneumonia set in day following operation. Pneumonia was the cause assigned for death. Before operation dulness over apex of right lung due to past pleuro-pneumonia was noted. The affection reappeared on same side.
- 26.—Male, aged 45. Restoration of portion of lower lip. Ether (Allis's inhaler). Respiratory tract. Small bottle per rectum (4 oz.), only ½ oz. given. After patient had been fully etherised by respiratory tract anæsthetic continued by conducting tube, from bottle per rectum, bottle immersed in water at 110° to 120° F. Operation finished in 20 minutes. Patient reacted well; 4 hours later only complained of slight discomfort about navel; 8 hours after operation went to closet; repeated this four or five times between 8 P.M. and 12 P.M. The attendant did not summon house surgeon till he found patient had passed some bloody fluid in bed. Patient then in state of collapse, and died at 3 P.M., 15 hours after operation. Ileo-colitis, with hæmorrhage, caused by action of ether vapour on intestinal walls, or sympathetic ganglia connected with them. Post mortem: Lungs: slightly emphysematous, pleuritic adhesions, and slight hypostatic congestion at left apex. Heart: small quantity of fluid in pericardial sac; valves normal; post-mortem clot in right ventricle. Liver: large, firm, and pale. Spleen: normal. Kidneys: congested, capsules not adherent. Stomach: empty, distended with gas. Small intestines: upper two-thirds empty, lower one-third mucous membrane intensely congested; organ contained fluid resembling blood, and few blood clots. Large intestine distended with gas, and contained quantity of bloody fluid; mucous membrane intensely congested. Patient of temperate habits, yet in fair physical condition. The recorder of case hitherto thought that in cases of rectal etherisation no danger was incurred except in employing too much ether in too short a time, but was now forced to admit that there were dangers connected with it which could not be foreseen, and therefore only advised its use in very prolonged operations about mouth and pharynx.

Series C, I.—Deaths occurring in Hospitals.

- 1.—Female, 50. Colotomy. Death after 15 hours. Acute bronchorrhœa.
- 2.—Female, aged 58. For strangulated hernia. Ether (Clover's). Heart failed before respiration. Syncope. Post mortem: Both lungs very emphysematous, chronic bronchitis, myocardium very fatty, straw-coloured clot in right ventricle and pulmonary artery, other cavities empty. Lunatic; had been asthmatic for years from chronic bronchitis and emphysema.
- 3.—Male, 56. Exploratory section for strangulated hernia. Death, after vomiting, from being moved when *in extremis*, and a few inhalations of ether. Patient had been operated on a few days previously and, as just said, was *in extremis*.
- 4.—Female, 35. Amputation of breast, two minutes. Pulse failed first, pulse and respiration stopped suddenly. Syncope. A soft and weak pulse and aortic regurgitation had been noted.
- 5.—Female. Removal of sloughing fibroid. Died suddenly, vomiting blood, 5 minutes after having been put back in bed. Operation undertaken as a last resource.
- 6.—Ether given per rectum. No particulars.
- 7.—Female, aged 32. Removal of ovarian cyst without adhesions. Ether given on towel rolled into cone. Respiration failed first. Symptoms at first favourable. After large quantity of fluid had escaped from cyst, and cyst grew smaller, respiration at once affected, as heart and lungs occupied less cramped quarters. Respiration grew shallow rapidly and in 2 minutes had ceased. Pulse failed and ceased soon after. Artificial respiration kept up 45 minutes (during which time cyst was removed and operation completed), together with hypodermic of ether and brandy, sinapisms to extremities and precordium, heat, &c. Respiration then returned, but only for ten minutes. Death caused by inhibition of respiration. No post mortem. Possibly nervous. Tumour so large that heart and lungs were much crowded out of usual area.¹
- 8.—For ununited fracture of inferior maxilla. Death from extreme weakness.
- 9.—Male, 54. Extraction of 4 teeth and removal of portion of upper jaw-bone for caries. Ether given (1 drachm) from an inhaler. Face turned blue. Artificial respiration and galvanism. Died. Asphyxia from entrance of blood into air passages. Patient lying on his back; the blood gravitated into trachea. Post mortem: No blood in trachea; fatty heart.
- 10.—Male. Circumcision. Ether from inhaler. After completion of operation patient vomited, and food entered trachea; a mass dislodged with finger. Laryngotomy. Death. Post mortem: Showed a second wedge of meat impacted low down in the trachea. Patient had been warned not to eat, and stated he had not done so.
- 11.—Excision of enlarged tonsil. Ether. Deeply under; blood collected in air passages producing asphyxia.

Series C, II.—Deaths occurring in Private Practice.

- 1.—Female. Ether given in Ormsby's inhaler. Asphyxiated by inhaler.²
- 2.—Male, aged 19. Thyroid (removal), 30 minutes. Ether (Clover's inhaler). Simultaneous failure of heart and respiration. Post mortem: No organic disease beyond narrowing and flattening of trachea from pressure. Deaf-mute.
- 3.—Sarcoma on side of chest (removal). Ether (Clover's inhaler). No post-mortem.

¹ Danger attributed more to secondary causes than to anæsthetic.

² See British Medical Journal, July 15th, 1882, p. 103. The reporter says: "At the time of death I regarded it as one of asphyxia, due to the inhaler, and the condition of the heart confirms, it seems to me, this view."

UNTOWARD CASES OCCURRING DURING THE ADMINISTRATION OF ETHER.

These are the cases in which, although happily a fatal termination was obviated, yet symptoms arose which gave rise to grave alarm and necessitated resort being had to measures adapted for resuscitation.

The sexes were attacked equally, the ages ranged from 2 to 70 years; the women affected were, as a rule, somewhat younger than the males. Of the reports which have reached us more refer to private than to hospital practice.

Records of untoward cases have come to us from various parts of England, Germany, and the United States, most being derived from this last region, where, as above stated, ether is very largely given.

FAILURE OF PULSE AND RESPIRATION.

In most cases the pulse and respiration failed together, or respiration ceased before cardiac failure; but in very many instances no record was kept of this important point.

NATURE OF OPERATION.

For diseased bone; for removal of breast or abscission of a tumour from the breast; upon the chest to secure permanent opening in a case of long-standing empyema; for dislocations; on the eye, excision of globe, iridectomy, on eyelid; removal of submaxillary glands; genito-urinary tract, catheterism, perineal section, for phimosis; on neck, scraping tubercular glands; tracheotomy; for examination of diseased hip; other examination; in four cases operation not commenced.

The only Predisposing Cause mentioned in these cases is the occurrence of vomiting in three patients, and a temperature of 104° F. in another; intemperance is noted in one case. Notes are, however, in some instances given, referring to the state of the patient's health at the time of the occurrence. Thus, debility; mitral incompetence; extensive valvular disease; uterine neuralgia are mentioned, and in one case we are told that there was extreme excitation of the vascular system succeeded by collapse.

METHOD OF ADMINISTRATION.

On a towel; on a sponge covered with flannel; on a sponge covered with leather; in a cone; various forms of inhaler the make of which is not specified; in Ormsby's inhaler; in Clover's inhaler; by the rectum. These facts are of especial value, for with the exception of the two inhalers above mentioned and possibly of the cone, the method employed was clearly not the one most likely to achieve rapid and quiet etherisation. The furious struggling and distress which accompanies some methods of exhibiting ether would go far to account for many of the "untoward systems" ascribed to the ether. In the rectal etherisation no mention is made of the use of the anteceptor, which has been shown to be so essential for the safety of this method.

METHOD ADOPTED TO EFFECT RESUSCITATION.

The following measures were used: artificial respiration by various methods; electrical excitation; inversion of the body; rolling to left side; various forms of stimulation, both locally, as by heat or cold affusion; and internally by hypodermic injections of atropin; rectal injections of beef-tea and brandy; inhalation of amyl nitrite sprinkled on lint and held to the nostrils; pulling out of the tongue; tracheotomy.

RECORD OF CASES.

Series A, None.

Series B.

- 1.—Female, aged 10. Removal of wen from eyelid. Ether given on cone. The untoward symptoms were: Epileptiform condition, with complete insensibility. The operation was performed. The measure for resuscitation adopted was suspension of the inhalation. The reporter of this case says: "Condition alarming in appearance, but has never within my knowledge had any serious result." The patient crying violently when cone put over her face.

- 2.—Female, aged 16. For excision of eyeball. Ether given in a leather inhaler. Pulse failed first. Pulse from beginning was feeble, and grew imperceptible; respiration became very shallow. Resuscitation: Rolling on left side for a moment; slapping over cardiac region; artificial respiration. Before battery could be applied, pulse began to act feebly, and at length recovered. Operation performed, and patient recovered. This patient was weakened by recent illness. This case was recorded to show that ether does not always stimulate the heart's action.
- 3.—For establishing and making permanent opening in thorax for drainage. Suddenly turned livid when pleura between 9th and 10th ribs was reached. Resuscitated with extreme difficulty. No particulars of measures resorted to are stated.
- 4.—Dangerous symptoms occurred, but no further particulars given.
- 5.—Aged 8. Iridectomy. Untoward symptoms: When operation was completed, and dressing terminated, great pallor of the face was observed. Resuscitation: A few manoeuvres were required to put an end to this condition.
- 6.—Young boy. Pulse and respiration failed together. Untoward symptoms: Became very pale; pulse at wrist could not be felt, and breathing seemed suspended. Resuscitation: Artificial respiration and other means; after much perseverance animation restored. Ether (for local anaesthesia) used in mistake for sulphuric ether. This was supposed to have caused the alarming symptoms.
- 7.—Female, aged 14. For necrosis of tibia. Ether, 1 oz. given on a sponge in leather cone. Pulse failed first. Untoward symptoms: Became suddenly blue in face; jaws closed with spasm, and pulse could not be felt. Resuscitation: Pulling out tongue; turning on left side; artificial respiration. Patient gave few gasps, vomited, and at last recovered.
- 8.—Male, aged 44. Removal of left eyeball (about 7 minutes). Ether given in a conical sponge lined with flannel. Respiration failed first. Untoward symptoms: As bleeding tissues were about to be compressed, no haemorrhage observed. Lips and whole face pale, and respiration had ceased. Resuscitation: Artificial respiration commenced. Pulse very feeble. Tongue drawn forwards. Patient made one or two efforts to breathe. Nitrite of amyl (4 min. on lint) given, and artificial respiration continued, but patient soon breathed naturally, and quickly recovered consciousness. Patient strong, healthy looking. Had slight mitral regurgitant murmur, and suffered occasionally in his breathing after hard work.
- 9.—Male, aged 11. Removal of submaxillary glands. Ether, 9 oz. given on sponge inhaler. Untoward symptoms: Vomited twice; after operation respiration and pulse weak, and later almost failing, this state lasting more than 4 hours. Pupils contracted to pin's point, body cold and clammy. Resuscitation: Artificial respiration; friction; hot flannels; ammonia to nostrils; faradic current over phrenic nerve and to diaphragm; enemata of beef-tea and brandy; application of hot flannels, which last improved pulse and respiration.
- 10.—Female, aged 14. Examination of diseased hip, and applying splint. Ether given in an American inhaler (? cone). Untoward symptoms: Respiration shallow; face became blanched. Inhaler removed, but pulse failed, though heart still beating. Resuscitation: Pillow removed from under head, and chin thrown upwards; flipping with cold wet towel; pulse and respiration restored. On moving joint, patient showed signs of pain, so little more ether given at intervals. Pulse did not fail, though respiration feeble. Operation performed, and 20 minutes from beginning of inhalation, patient awoke.
- 11.—Female, aged 14. Same patient as above case, but different occasion. Reduction of redislocation of hip. Ether given in an inhaler. 1 oz. 2 dr. Respiration failed first. Untoward symptoms: Breathing shallow; face pale, but pulse good. Resuscitation: Inhaler removed, as respiration almost imperceptible; flapping epigastrium with cold wet end of towel practised; this somewhat revived respiration. Small dose more of ether given as patient woke up. Respiration continued shallow throughout operation, but circulation never failed, because administrator was careful to remove inhaler when state of respiration required it.
- 12.—Female. Removal of tumour from breast. Untoward symptoms: At end of operation, face pale but pulse good. When ether discontinued, breathing faint, finally ceasing; pulse persisted. Resuscitation: Artificial respiration for a few moments restored natural breathing.
- 13.—Male, aged 36. Catheterism for rupture of urethra. Untoward symptoms: Spasm of glottis before anaesthesia was very profound. Resuscitation: Operation had been attempted previously under chloroform, but patient took it badly and operation was abandoned for the time. Tracheotomy had to be performed. The tracheal wound, still open, proved of great service; spasm disappeared; by closing tracheal wound respiration went on through glottis. (See also under Chloroform Cases.)
- 14.—Male, aged 70. Reduction of dislocation of left shoulder (four minutes). Ether given in Ormsby's inhaler. Pulse and respiration failed together. Untoward symptoms: After operation pulse and respiration ceased together, just before having been regular. Patient became leaden in colour. Resuscitation: Artificial respiration; cold water dashed over head. Patient made spasmodic gulp, battery applied to diaphragm, another gulp, then gradual recovery. Patient fairly robust, with moderately firm muscles. Accident occurred five weeks before and surgeon who attended never reduced luxation.
- 15-16.—Tracheotomy for diphtheria. "Danger appeared imminent." No further particulars.

17.—Female. Relief of uterine colic. Ether given on a towel, two dr. (after several doses morphia given hypodermically). Respiration and pulse probably failed together. Untoward symptoms: Ashy pallor overspread face and respiration ceased. Resuscitation: Vigorous slapping, thumping, and cold affusions; also two hypodermics (atropine sulph.). After resuscitation the uterine neuralgia still persisted and was finally relieved by chloral hyd. and potassium bromide.

18.—Male, aged 2. For phimosi. Pulse and respiration failed together. Untoward symptoms: Appeared in good condition shortly after operation, but became increasingly pale, then pulseless, with cessation of breathing—in state of collapse. Resuscitation: Was completely restored under artificial respiration. Note by reporter: Patient not fully under ether. Nervous and vascular systems highly excited—afterwards a reaction, condition of collapse.

19.—Female. Removal of breast. Untoward symptoms: Sudden spasm with serious asphyxial symptoms set in; and there was seen large bronchocele which had not been spoken of by patient, which may have contributed to this state.

20.—Child. Untoward symptoms: Pronation of fore-arm and wrist, inversion of thumbs, opisthotonos by boring head back in pillow, ending in convulsion. Convulsion not fatal, patient resuscitated.

21. Male, adult. Respiration failed first. Untoward symptoms: *Tetanic setting of inspiratory muscles of chest—viz.,* no air entering, respiration with diaphragm failing to fill lungs; mouth and larynx being free, tongue out, and position good. Respiration ceased, but pulse continued. Resuscitation: Artificial respiration (Silvester's method) and chest again inspired. No stridor at glottis. Operation completed without ether; good recovery.

22.—Female. Removal of cystic tumour of breast. Respiration failed before the pulse. Untoward symptoms: *Simple exhaustion*; breathing quiet, but both diaphragm and intercostals working, mouth open, and tongue out. After several imperfect respirations, deathly pallor over face, ears, neck, with dilatation of pupils, falling jaw, and cessation of breathing. Resuscitation: Artificial respiration and stimulation restored life. Tumour removed without ether. Made slow but good recovery. Very feeble.

23.—Male. Incision and perineal section for retention and urinary extravasation. Pulse and respiration failed together. Untoward symptoms: Breathing and pulse ceased. Resuscitation: Revived by artificial respiration and stimulation, and operation performed without ether. Died 10 days later. Post mortem: Extensive and old valvular disease of heart.

24.—Male. Removal of submaxillary gland. Ether (30 grm.) given per rectum by long tube. Suddenly cried out: "I am bursting," and abdomen was found to be considerably distended. The ether was discontinued as the man was now insensible and operation begun. For several hours the patient remained in a state of absolute coma, but eventually came round without any signs of rectal or other injury. Complete absence of cardiac disturbance.

25.—Male, aged 30. Scraping and removal of tuberculous lymphatic glands of neck. Ether given in Ormsby's inhaler. Untoward symptoms: Ether failed to produce complete loss of consciousness or sensation. The small operation done with difficulty on account of exaltation and struggling of patient. Chloroform refrained from, as it produced dangerous collapse on a former occasion.

26.—Ether per rectum. Untoward symptoms: Alarming symptoms supervened, because assistant allowed vapour to pass in too rapidly. Resuscitation: Excess of vapour immediately withdrawn by means of large rubber tube passed into rectum and colon; escape of vapour being aided by elevating pelvis and by pressure on abdomen.

Series C.—I. Cases occurring in Hospitals.

1.—Male, aged 60. Ether given by Clover's inhaler. Patient had bronchitis, which was the cause of the trouble. Dorsal decubitus posture.

2.—Male, aged 60. Amputation of gangrenous toe. Ether given in Clover's inhaler. Untoward symptoms: Patient remained delirious 3 days, and then died. Broken-down drunkard. Dorsal decubitus posture.

3.—Male, aged 40. Cock's operation. Ether given in Ormsby's inhaler. Respiration failed first. Untoward symptoms: Patient stopped breathing. Resuscitation: Artificial respiration; patient recovered, having at first exaggerated Cheyne Stoke's respiration.

4. Male, aged 44. Kelotomy. Ether (Ormsby's inhaler). Untoward symptoms: Sick before and during operation, but not afterwards. Though anæsthetic given successfully, this case, untoward in so far that pneumonia of right base of lung supervened 4 days after operation. Patient recovered.

5.—Female. Respiration and pulse failed together. Untoward symptoms: Breathing almost ceased and pulse failed, face became blanched. Was on the point of dying, not from asphyxia, but weak heart-action.

6-11.—Respiration failed first in each case. The untoward symptoms arose from vomiting and embarrassed respiration. Resuscitation: Artificial respiration and stimulants.

Series C.—II. Cases occurring in Private Practice.

1.—Male, aged 33. Abscess in mouth with carious teeth. Ether given in Clover's inhaler. Respiration and pulse probably failed simultaneously. Untoward symptoms: Became pulseless, cyanosed, and respiration dropped to 3 per minute. Resuscitative measures: Artificial respiration, with no good result; faradaic battery applied, which caused sneezing with the result that a quantity of pus escaped from the trachea. The abscess seems to have given way during the administration of the ether and to have entered air passages.

2.—Male, 53. Opening of pyæmic abscess in shoulder-joint. Ether (Clover's inhaler). Became rapidly pallid early during the administration. Pulse barely perceptible; breathing arrested. Artificial respiration alone needed. Patient suffering from pyæmia. Temperature, 104° F.

3. A few cases. Ether (Clover's inhaler). A few cases of syncope have occurred, also of semi asphyxia. They have invariably been restored by raising the limbs, lowering the head, pulling forward the tongue, artificial respiration, slapping chest with cold, wet towel, and access to air.

REMARKS ON ETHER DEATHS.

The deaths associated with or caused by ether which are recorded in the above tabulations are of especial interest; but few, if any, "sudden deaths" are recorded under this anæsthetic. Most arose through interference with respiration, and this interference was, in the large majority of instances, peripheral rather than central. In the cases in which the central nervous system became the direct cause of the failure of respiration it did so apparently rather as the result of the extreme exhaustion of the patient, due to some intercurrent disease—e.g., prolonged strangulation of the intestine, rather than to overdosage. That very many instances arise in which ether is pushed too far cannot be doubted, but these cases are as a rule easily brought back to life by the performance of artificial respiration. Mechanical asphyxia is recorded in several cases. Thus in Series B, 6 (Remote Deaths), a mass of liver had been vomited and sucked back into the trachea. In Case 10, same series, a mass of meat was found post-mortem in the same situation. In Cases 7, 11, 18, and 26 of this series vomiting and drawing into the air passages of the vomited matters were the cause of death. In other instances (No. 17) blood entered the trachea during the operation and suffocated the patient. Although these cases are classed as "remotely due to ether," it seems more than probable that they were "preventable" in the sense that greater precaution and attention to the detail of the anæsthesia might have resulted in obviating the catastrophe.

Some few cases of incomplete anæsthesia are reported, and death resulted as in those under chloroform to which reference has been made above. So, also, many instances of death following the administration of ether by some unsatisfactory appliance are given. In Case 30 a handkerchief was used; in Case 36 a sponge; and in Case 48 a pound of ether was expended over an operation on a delicate person within a time which could hardly have been more than one hour. Again, one death at least has resulted from the use of ether not adapted for inhalation, while another followed the placing of an empty inhaler over the patient's face when he was anæsthetised, and so suffocating him. All these deaths were probably preventable. Deaths due to surgical shock¹ are naturally somewhat frequent under ether, since that anæsthetic from its stimulating effect upon the circulation is commonly selected as more appropriate for patients whose general condition at the time of the operation is one of great vital depression.

DISEASES OF THE RESPIRATORY TRACT.

These would constitute a danger under ether. According to some the perils thus arising are immediate, and due to the irritant action of the ether upon the diseased structures of the trachea and bronchi; and remote, or occurring a few hours after the completion of the operation. In Series B, Cases 29, 38, 45, 61, C. 1 and 2, emphysema was present with some bronchitis; in Cases 23, 24, 25, pneumonia caused death, itself due to or aggravated by the ether. Bronchitis was present in Case 22, and acute bronchorrhœa in Case C. 1. Empyema, congestion of the lungs, bronchial catarrh, pul-

¹ Cf. Nos. 27, 23, 37, 40, 65, and "Remote Cases," 13.

monary complications are also reported. Interference with respiration due to goitre (Case 56 in "Remote" class)—which, however, was associated with hæmorrhage—and a case of bronchocele constitute a further complication. It is noteworthy that comparatively little mention is made of patients dying from pulmonary affections initiated by the ether.

CIRCULATORY FAILURE.

A comparatively small number of cases are reported in which ether anaesthesia is reported to have caused circulatory failure. In the experiments conducted by the Hyderabad Commission ether was thought to behave in much the same manner as chloroform, but the clinical reports of deaths show that observers regard circulatory failure as a determining cause, and the most frequent one of heart failure, under chloroform, attributing to ether danger rather to the respiratory and renal systems. In Cases 50 and 57 heart failure occurred, but was associated with severe hæmorrhage. In Case 74 heart failure occurred in a very anæmic patient aged twenty, and the same in Case 77, Case 63, and possibly Cases 64 and 75. In Case 55 a patient was exhausted by cancerous disease; Case 51 is put down as "paralysis" of the heart, but probably was one of cardiac failure in an enfeebled person. Among the "remote" Case 17 deserves notice. A large pleuritic effusion was tapped, and heart failure followed with clotting in the heart. In these cases failure of respiration occurred almost immediately after the heart stopped, and simultaneously.

ETHER IN RENAL DISEASE.

With regard to the kidneys, a granular condition was described in Cases 22 and 32; cystic disease in Case 33, in which the vessels at the base of the brain were affected; tubercle in Cases 65, 71, and 72; and diseased in Case 43. In Case 72 of the "remote" deaths the kidneys were diseased, as they were probably in Case 21. In no cases are reliable facts given pointing to nephritic trouble *following* the use of ether.

SEVERE OPERATIONS AND HERNIOTOMIES.

A remarkable fact is the frequency of death under ether when an operation was being performed for the relief of strangulated hernia or intestinal obstruction due to other causes. The following are instances of this: Cases 27, 32, 43, 49, 54, 58, 35, and 39. In many of these, no doubt, the patient being *in extremis*, ether was given rather than chloroform, and in others vomiting and inspiring of faecal vomit occurred and ended fatally.

Several operations upon the tongue and jaws seem to have ended fatally from blood entering the windpipe as the patient was seated. Only one doubtful case of cerebral hæmorrhage following ether is reported. The evidence seems, then, to indicate that ether is used mostly in middle life, and, although dangerous to persons suffering from active pulmonary or renal mischief, is seldom responsible for starting it *de novo*.

PART III.—NITROUS OXIDE.

The reports of some thirteen cases of deaths have been recorded, but, as an examination of the cases themselves will show, it is very doubtful whether these fatalities can be ascribed to the influence of this anæsthetic. The youngest patient was 10 and the oldest 71. Most deaths have taken place in private practice, and records have come from Canada, France, England, Scotland, and the United States.

The pulse is stated to have failed before respiration in one case and once simultaneously with it.

In all cases the operation was for the extraction of teeth or stumps, and in three instances the operation had not been commenced at the time of death.

Intemperance is stated in one case to have been a possible adjuvant cause; in another the patient was dying from cancer; and in a third the case was complicated by vomiting.

The causes of death, as assigned by the reporters, were as follows: asphyxia; fright, the patient not being under the influence of the gas at all; congestion of the lungs, which was noticed two hours after the administration, and eventually proved fatal; the last stage of phthisis; respiratory failure through impaction (1) of a broken gag in larynx, (2) of a molar tooth in the larynx; syncope (simple) in three cases; from incomplete anæsthesia and shock of tooth drawing; from tight lacing forcing the heart out of position by the distended stomach.

The measures adopted for resuscitation, as far as recorded, were: artificial respiration, electric stimulation of phrenic by galvanic current, by faradic current; prone position; stimulation by rubbing, slapping, cold affusions; drawing forward of tongue; tracheotomy.

Post-mortem examination of persons dying under Nitrous Oxide revealed:

- (1) Lungs tubercular—badly diseased.
- (2) Heart fatty, atheromatous aorta, thickening of valves, right heart distended, left empty. Lungs engorged. Dark fluid blood between scalp and periosteum. Dura mater adherent, serous effusion into ventricles.
- (3) Molar tooth impacted in larynx.
- (4) Lungs and kidneys congested, adherent pleuræ, thickening of aortic valve.
- (5) Fatty degeneration of heart.

DEATHS UNDER OR AFTER NITROUS OXIDE.

- 1.—Male, adult. Extraction of teeth. After the extraction of the teeth the patient rapidly sank, and died in two hours. Congestion of lungs. Post mortem: One lung diseased, other almost consumed by disease. Patient, it was presumed, died because lungs were in last stage of phthisis.
- 2.—Adult. Extraction of teeth. No particulars given, except that it was stated that the patient was healthy.
- 3.—Female, aged 17. Dental operation. After inhaling gas, was taken ill, although she did not take sufficient to produce insensibility. Died the following day. Was of strong and robust physical constitution and apparently in good health before inhaling gas. The gas was made and administered by a travelling showman and was thought to be impure.
- 4.—Female, adult. Extraction of front tooth (loose). Patient inhaled gas three times in succession, each time taking but a small quantity, being equally fearful of the anæsthetic and of the pain of operation. Finally, choosing to submit to operation without gas, teeth were extracted. Immediately fainted, head dropping sideways. Face became livid, then purple. Battery and artificial respiration resorted to, but death took place in 13 minutes, face becoming blanched after death. Nervous shock from dread of pain and fear of fatal effects from inhaling gas. Verdict, at inquest, of jury composed of medical men, stated death to be due to asphyxia from inhaling gas; but it would appear not enough was inhaled to produce such a result. The patient, further, was not under gas at the time the

grave symptoms occurred. Post-mortem appearances: Conflicting evidence given—(1) one lung more engorged than other, but healthy; (2) one lung congested; (3) lungs congested, right lung bound by old pleuritic adhesions. Upper lobes of right lung pneumonic.

- 5.—Female. Dental operation. Post-mortem: Lungs in state produced by asphyxia.
- 6.—Female, aged 38. Extraction of tooth. Pulse said to have failed first. At beginning of administration patient's pulse rapid and less full. It was determined to operate without gas, but as patient could not bear the pain, gas was again given. After operation face became livid and features began to swell. Though efforts were made to restore animation, she breathed only two or three times, and a few moments after her pulse ceased beating. Inhalation of nitrous oxide gas inducing paralysis of respiration, though after the first administration there was rapid pulse with diminished volume. Cause of death said to be the impaction of a portion of a broken gag in the larynx. [For controversy on the cause of this death see *THE LANCET*, vol. i. 1873, pp. 212, 245, 253.] No post mortem allowed. Believed to be of good health; of plethoric habit.
- 7.—Dental operation. No particulars given.
- 8.—Male. Removal of stumps of teeth for alveolar abscess. Pulse failed first. Operation commenced before complete anæsthesia was obtained, and patient begged several times for more gas, but seems never to have been completely under its influence. After operation, was observed to be very quiet. Cold water dashed over face, and windows and doors thrown open. Face and neck livid, eyes fixed and open, pupils widely dilated. Hands cold and pale, but feet and legs quite warm. Cold affusions; artificial respiration; friction revulsions to feet and legs; galvanic battery—all unavailing. "Death from syncope" (verdict at inquest). Post mortem: Dark fluid blood between scalp and periosteum; dura mater very adherent; membranes full of serous fluid, and veins intensely congested; ventricles filled with same fluid. Lungs dark-coloured and congested. Heart enlarged, soft and friable; left side quite empty, right full of dark-fluid blood; deposit of fat in inter-ventricular furrows; aorta coated with atheromatous deposit; aortic and mitral valves thickened. Liver enlarged; in state of fatty degeneration. Patient was suffering from alveolar abscess caused by carious stumps, and could get no rest at night.
- 9.—Male, aged 10 or 11. Extraction of temporary teeth. Towards close of operation gag slipped, and mouth closed, patient became partly conscious, assuming natural colour, when he took deep inspiration, and immediately showed symptoms of asphyxia. Raising hand to neck, he attempted to tear away clothes, although they were loose. Laying patient flat, and slapping across the back were of no avail. Tooth could not be felt. Medical man fetched, who arrived at 7 minutes, but patient was then dead. Tracheotomy at once performed, without avail. Post mortem: Missing lower molar found firmly fixed in larynx with fangs uppermost.
- 10.—Male, aged 57. Extraction of teeth. Extraction about to be begun, when patient seemed breathless—even lifeless. Tongue was drawn forward, water dashed on face, and artificial respiration begun and carried on for $\frac{1}{2}$ hour. Syncope. Post mortem: Brain: dura mater firmly adherent to calvarium. Heart: Visceral pericardium presented few small whitish patches of fibrinous thickening. Valves normal, except soft, milky, fibrinous vegetation on one of the aortic valves. No fatty degeneration. Lungs: right firmly bound to chest wall; lower lobe collapsed and atrophied; left large and slightly congested. Kidneys congested. Had a cancerous enlargement of tongue, which at post-mortem was found not to involve larynx. This patient was in a terribly shattered state of health at time of occurrence, the cancer having reduced him almost to a state of collapse.
- 11.—Male. Dental operation. Nitrous oxide given without legal authority. Syncope was assigned as cause of death. The administrator was tried by 8th Chamber of Paris Tribunal for homicide, in causing the death of the patient, and fined 600 frs., and ordered to pay 3000 frs. damages.
- 12.—Female, aged 71. Extraction of teeth, &c. The pulse and respiration failed together. At the commencement of the inhalation patient's respiration noticed to be insufficient. When patient became unconscious, and teeth had been removed, &c., she suddenly changed colour and became livid, while heart and respiration ceased. Syncope caused by impairment of respiration through tight lacing and over distension of stomach, both acting on a heart diseased and weakened by fear. Patient suffered from fatty degeneration, and was aware of it. She had breakfasted 3 hours before taking the gas, but digestion was wholly suspended by extreme terror at operation. Addicted to excessive tight lacing.

13.—Male, aged 24. Extraction of tooth. As soon as tooth had been extracted patient gave a gasp and expired. Artificial respiration with no effect. Syncope, due to incomplete anaesthesia. Heart and lungs examined previous to inhalation, and considered sound. The purity of the nitrous oxide was tested shortly after the accident.

UNTOWARD CASES.

We next pass to the reports of three "untoward" cases recorded as having occurred under the influence of nitrous oxide gas.

1.—Female, aged 30. Extraction of tooth. After a few inspirations became unconscious; pulse ceased; breathing stopped. Pulling

forward tongue; artificial respiration; breathing at length became normal.

2.—Female, adult. Extraction of tooth. Acute and convulsive movement during narcotism, but recovered. Walked 400 yards to station and was in train when seized with faintness, pallor, and active convulsion. Was put to bed unconscious. Next day insensible, pupils widely dilated, pulse irregular and weak, breathing feeble. Was sometimes convulsed. Breath with peculiar factor; odour of sulphur alcohol. Was treated as for hysteria; recovery not perfect for several weeks.

3.—Female. Removal of 2 molar teeth. Dentist who operated also gave the gas. Respiration failed first. Administrator noticed that patient (a little girl) was not breathing. Artificial respiration, which was successful in bringing patient round. At the critical moment administrator was too much occupied in operating to notice sudden stoppage of respiration. He thought that had he been operating unassisted he would certainly have lost his patient.

PART IV.—METHYLENE.

The anæsthetic which for some years has been known as methylene or bichloride of methylene, and is usually believed to consist of a mixture of chloroform and alcohol, has given rise to several deaths. The deaths have been more frequent among males, and between the ages of 16 and 51. Deaths are reported from various parts of England, and have occurred mainly in hospital practice. In most cases the pulse failed before the cessation of respiration; but nearly as frequently the pulse and respiration are reported to have failed simultaneously. The deaths have occurred during a variety of major and minor operations which need no further mention, and in two cases before the commencement of the operation. No special symptoms or complications are reported which might presumably have predisposed to the fatality. The causes assigned for death were: asphyxia; collapse; collapse due to mental perturbation; exhaustion and hæmorrhage; failure of heart; failure of respiration; shock; reflex shock; syncope; syncope due to imperfect anæsthesia; syncope following violent struggling. The methods of administration were: a "flannel bag"; "inhaler," the variety not being named; leather inhaler; leather and flannel inhaler (? Rendle's mask); Rendle's mask; on lint; Junker's inhaler. The measures adopted for resuscitation were; artificial respiration; electrical stimulation; inversion (partial); usual methods of stimulation: traction on the tongue; rolling patient on to his side. The post-mortem examinations revealed the following conditions:—(1) Congested lungs; (2) Fatty heart, congested lungs; (3) Hypertrophy of left ventricle, right distended; (4) Heart dilated and fatty, lungs oedematous, kidneys congested. It is noticeable that in Cases 1 and 3, 12 and 16 the patient was apparently seated in a chair at the time of the administration, a dangerous posture for chloroform and its mixtures. In Cases 2 and 14 there was excessive struggling, and in these as well as in Case 4 the death was clearly due to an overdose. In Cases 2, 7, 8 and in 1 and 2 of the "untoward" cases the operation being performed was upon the eye. As a rule a deeper anæsthesia is aimed at for these cases. In Case 13 incomplete anæsthesia appears to have been the cause of the trouble. In Case 12 a dentist gave the anæsthetic. Among the untoward cases "bronchitis" is mentioned as an after-effect of this anæsthetic.

- 1.—Male, aged 39. For malignant disease of left antrum. 1½ dr. given in an inhaler. Pulse failed first. Head gradually fell back; pulse, already feeble, ceased; no stertor or lividity. Laid horizontally, and galvanism and respiration practised with no result. (1) Through feeble condition and hæmorrhage; (2) mental depression; (3) want of expiratory power increased by bandage round abdomen to prevent struggling. The tumour extended upwards, and pressed on malar bone, producing slight ecchymosis under eye; it also protruded from nostril.
- 2.—Male, aged 40. For double iridectomy. Pulse and respiration failed together. Became very violent; struggles restrained; turned blue; struggling ceased; methylene removed; operation on right eye completed. During operation on left showed signs of feeling pain. After 3 minutes respiration became shallow and cat. hing, radial pulse could not be felt. Angles of mouth blue. Was turned on left side. A few gasping inspirations. Galvanic current tried for 10 minutes. Artificial respiration for 1 hour. ? Syncope. Post-mortem: Heart, on surface of left ventricle about 20 small spots of ecchymosis, left ventricle empty and contracted, right contained fluid blood. Lungs congested.
- 3.—Male, aged 41. Amputation of finger. Pulse and respiration failed together. When operation was performed, patient's head had fallen on one side, eyes were upturned, and breathing and pulsation had ceased. Every means taken to restore animation without effect. The reporter says: "As patient was in a great state of excitement at having to undergo operation, methylene acted on nervous system, producing instant death." Post-mortem appearances *nil*.
- 4.—Female, aged 44. For cancer in breast. Flannel bag, small quantity. After 2 or 3 convulsive gasps patient expired. Artificial respiration and other means for restoration used without success.

- 5.—Male, aged 51. Reduction of dislocation of arm and shoulder. Pulse and respiration failed together. Face became livid and breathing suspended; pulse falling also. Measures resorted to were: Drawing forward tongue, giving of ammonia, and application of galvanism for ½ hour without effect. Operation not performed. Post-mortem: Heart large and flabby, but no other disease.
- 6.—Male, aged 48. For fistula in ano. 2 dr. (leather inhaler). Pulse and respiration failed together. During inhalation the patient became very rigid, with complete opisthotonos. Was turned on left side, became very livid, respiration ceased, pulse imperceptible. Measures resorted to were: Artificial respiration (Silvester's method); galvanism to diaphragm and phrenic nerve; brandy injection per rectum—all with no avail. Pupils contracted when first asphyxiated, after 3 minutes became dilated, and remained so. Asphyxia was assigned as cause of death. Post-mortem: Lungs congested; lining membrane of trachea and bronchi studded with ecchymoses; right pleura adherent to ribs. Heart large and flabby, covered with fat, valves healthy; some fibres, with commencing degeneration, but no fat globules; heart empty. Blood fluid, and very dark. Aorta atheromatous. Liver large and fatty.
- 7.—Female, aged 25. Passing probe through obstruction in lachrymal sac (2 minutes). 3 dr. given in leather inhaler covered with flannel. Pulse failed first. Breathing became loud and stertorous, with palatal stertor, and nostrils flaccid. Pulse at wrist failed, and then ceased suddenly. Respiration continued, but failed suddenly. Tongue dragged forward, and artificial respiration (Silvester's method). Lower limbs and pelvis raised from couch to cause gravitation of blood to the brain. Face and breast slapped with wet towel, and ammonia applied to nostrils. Injection of brandy and ammonia per rectum. A few inspirations, but no return to life.
- 8.—Male, aged 27. Iridectomy. Breathing became slow and stertorous. Artificial respiration, galvanism, &c., tried, but respiration became more irregular, face more livid, and patient died. Post-mortem appearances *nil*, except that blood was dark and fluid.
- 9.—Male. Amputation of foot above ankle-joint. Methylene given on lint. Before the dressing of the stump was completed it was observed that the patient was pulseless, and that respiration had ceased. Artificial respiration was attempted without success.
- 10.—Male, aged 40. Death was perfectly sudden and inexplicable. In apparently perfect health.
- 11.—Female, aged 27. Ovariectomy for cyst of the right parovarian (10 minutes). Methylene (4 dr.) given on Junker's inhaler. Clinical assistant greatly experienced in giving anæsthetics. Pulse failed first. After 10 minutes, during which 4 dr. were inhaled without producing complete anæsthesia, radial pulse suddenly stopped; respiration continued for 3 minutes after pulse ceased beating. Patient pale, and slightly livid. Measures used for resuscitation were: Lowering of head, drawing forward tongue; artificial respiration (Silvester's method), with free admission of fresh air from window; rubbing lower limbs with hot flannel; application of ammonia to nose, and subcutaneous injections of solution of musk—all of no avail. No information given by the necropsy as to the cause of death. Post-mortem: Heart; flaccid, of proportionate size to the body, valves and endocardium normal; fluid, bright-coloured blood, mixed with air-bubbles contained in ventricles; a few small, soft clots of fibrine in auricles, lining membrane of aorta delicate and normal; no evidence of any pathological alteration in heart, which was normal in its structures; air-bubbles in ventricles being post-mortem production. Brain: dura mater normal, meninges and substance of brain pale, anæmic, and oedematous. Small quantity of mucus in trachea, mucous membrane of which, as well as of larynx and pharynx, pale. Lungs: both free; anterior portions pale; posterior regions with moderate quantity of blood; both oedematous; tablespoonful of clear serum in pleural cavity, and about 100 centimetres of similar serum in pericardiac cavity. Patient anæmic and weak, on which account particular precautions and care are needed in giving anæsthetic. The remainder of the narcotic fluid was handed over to Professor Dr. Hofmeister for analysis. The result of this analysis proved that the "so-called chloride of methylene was chloroform diluted with absolute alcohol." No decomposition of the constituent chloroform of the preparation could be discovered. The fluid was obtained from London.
- 12.—Male, aged 16. Extraction of tooth. Administered by a dentist. Pulse failed first. Patient's (a boy) head dropped, he turned pale and gasped for breath; restorative administered, and medical man summoned, but death took place. Syncope.

* For verbatim account of the analysis see British Medical Journal, July 21st, 1883, p. 104.

- 13.—Male, aged 19. Suture of right ulnar nerve. Methylene given in a leather mask. Pulse failed first. Patient struggled violently from commencement, and was anaesthetised with difficulty. At commencement of operation patient became cyanosed, heart's action having suddenly ceased, and pulse giving no indication of danger. Syncope. Post mortem: Right ventricle full of blood, left ventricle slightly hypertrophied and contracted; valves of heart quite healthy. Death also considered due to "fatal inhibitory impulse excited by the incision, acting upon the heart during semi-narcosis" (*THE LANCET*, Feb. 14th, 1885, p. 316). Patient had been injured 6 months previously by an explosion of gunpowder. Some stones had penetrated the arm, and right ulnar nerve was divided. A month before the fatal dose he was put under methylene, which he took well, for the extraction of the stones.
- 14.—Male, aged 15. Amputation of leg for necrosis of tibia, &c. Pulse and respiration failed together. Struggled violently and became very cyanosed. Ceased struggling and face became leaden-hued; pulse and respiration stopped. Measures adopted were: Legs raised, head lowered, artificial respiration begun and carried on half-hour, brandy and ether injected, bot flannels over heart. Interrupted current one side over heart, other over left side of neck. At beginning of artificial respiration patient gave two deep drawn gasps, otherwise no sign of life. Sudden syncope. Post mortem: Lungs congested and oedematous at bases; heart, ventricles dilated, thin walls; heart substance light coloured, soft, friable; endocardium pale; no valvular lesion; ventricles in diastole, with fluid blood; kidneys large and congested; spleen enlarged, with cicatrix of old gumma; liver small, hard, cirrhotic. As to what share the inhaler used might have had in causing death see *THE LANCET*, Oct. 25th, 1890, p. 898. Patient had necrosis of tibia and disorganisation of left ankle-joint. Gave history of syphilis 16 years previous. Some necrosis of right tibia, and nasal septum almost destroyed.
- 15.—Removal of cancerous growth (20 minutes). The operation was partly completed, the patient having been under the anæsthetic for 20 minutes.
- 16.—Female, aged 27. Extraction of tooth. About 3 dr. of bichl. methylene. After a few inspirations the pulse was noticed to fail, and although various measures were used it was found impossible to resuscitate her. Death took place from engorgement of the lungs and asphyxia. Post mortem: heart healthy.

- 17.—Female. The operation was a gynæcological one. Died before commencement of operation. No post-mortem.

UNTOWARD CASES OCCURRING UNDER METHYLENE.

These are too few to need any analysis in this place.

- 1.—Infant. Operation on eye. Sudden syncope. Symptoms passed off quickly under appropriate treatment.
- 2.—Male, aged 17. Extirpation of eyeball (8 minutes). Methylene given in Junker's inhaler. Pulse and respiration failed together. After operation and removal of inhaler patient gave feeble sigh, head rolled on one side, and he ceased to breathe; face blanched, and no pulsation at carotids or heart. Flapping epigastrium with wet towel, pulling forward tongue, laying patient on left side. Patient then pushed over operating table till head almost in contact with floor, and in this position artificial respiration performed, while tongue held forward with forceps. After 5 minutes a feeble sigh and faint pulsation. Gradually patient recovered completely.
- 3.—General cases of females. Ovariectomy.—In some cases bronchitis said to have occurred as a result of the anæsthetic. Recorder refers to several cases, no particulars given; lays stress on use of pure drugs.

NATURE OF OPERATIONS NOT MENTIONED.

- 1.—More than one case. Methylene given in Junker's inhaler. Nitrite of amyl; inversion; and artificial inspiration.
- 2.—One or two cases. Methylene in leather case and towel covering it. Artificial respiration, successful after one minute's use.
- 3.—Female, aged 27. Extraction (time very short). Chloroform and methylalcohol (4 pts. to 1). Pulse: Whilst quickly breathing she suddenly became pale; the pupils dilated, and cold sweat came on forehead. Tongue pulled forward and artificial respiration used, when she slowly revived. Her mother died under chloroform.

PART V.—BROMIDE OF ETHYL.

The cases of death under this anæsthetic are two, which are appended. In these it would appear, however, that bromide of ethyl was not the cause of death. In both cases the substance used was impure, and it is probable that free bromine was present in the vapour employed. In the first case the length of the administration (one hour and a-half) would have rendered even pure bromide of ethyl very dangerous, since all authorities state that it is suitable for only very brief operations; and some go so far as to insist that a reapplication of the inhaler should never be permitted. Other deaths have occurred, but detailed accounts have not reached this country.

- 1.—Female, aged 25. Battey's operation (over 1½ hour). Rapid breathing and vomiting. Second attack of vomiting at end of 40 minutes with severe straining. On 3 occasions epistho-

tonos, with twitching and rigidity of muscles and limbs and rolling of eyes. No marked dilatation of pupils. Recovered quickly from anæsthesia, but had retching and vomiting. Complained at once of violent pain in head. Was given ½ gr. morphine hypodermically. The dose repeated in an hour. During the night the symptoms were nausea, retching, diarrhœa, and suppression of urine. Death took place 21 hours after operation, after convulsions and delirium. The diarrhœal discharges and also breath smelt strongly of bromide of ethyl. Uræmic poisoning induced by bromide of ethyl (probably). Post-mortem: Kidneys, microscopically, interstitial connective tissue slightly increased; swollen and coarsely granular. Epithelia in tubules and narrowed central calibre—sign of acute nephritis. 2½ oz. bloody serum in peritoneal cavity, and 3 dr. in Douglas's pouch below retroverted uterus. Patient subject to epileptic fits.

- 2.—Male. For stone in bladder. Died as soon as first incision was being made, and respiration becoming affected. No marked cyanosis. All efforts for recovery unavailable. The man was far gone in phthisis and greatly debilitated.

PART VI.—ETHIDENE DICHLORIDE.

Deaths under this anæsthetic have occurred. Although never largely used, three fatalities are reported, and of these, two at least, and perhaps all three, were due to failure of the circulation.

- 1.—Male, aged 29. Pulse probably failed first. Died before commencement of operation. Failure of heart from fatty degeneration whilst inhaling the bichloride of ethidene previous to operation; verdict given was death from misadventure. Post-mortem held.
- 2.—Male, aged 45. For incision and insertion of drainage-tube for empyema. Ethidene. Pulse and respiration failed together. Pupils became widely dilated. Measures adopted were: Artificial respiration; stimulants to heart: (1) slapping cardiac region with hand; (2) by needle and galvanic current. ? Syncope, or shock. Post-mortem: Trocar, with cannula,

inserted, and 72 oz. pus withdrawn. Right lung adherent to ribs. Heart: right auricle and ventricle with much dark fluid blood; tricuspid valve admitting 4 fingers; left ventricle empty. Right lung collapsed; pleura thickened; 10 oz. pus in cavity; lung much engorged with blood; pyramidal abscess in lung surrounded by patch of pneumonia. No fatty degeneration. Operation painful and prolonged, but danger great when lung diseased.

- 3.—Male, aged 26. Extraction of foreign body from right eye. Ethidene dichloride. Pulse probably failed first. Operation performed, and almost at once pulse became feeble and patient very pale. Head was lowered, tongue drawn forwards, artificial respiration, nitrite of amyl to nostrils, and inversion all with no result. Artificial respiration was carried on ½ hour. Syncope. Post-mortem: Heart flabby; walls thin; valves healthy; aorta with fatty patches; heart muscle with extensive granular degeneration. Lower lobe of right lung deeply congested. No cardiac murmur detected before operation, but sounds at base not distinct.

PART VII.—MIXTURES OF CHLOROFORM AND OTHER ANÆSTHETICS.

MIXTURES OF CHLOROFORM AND ETHER.

Several deaths have been reported as occurring under various mixtures of chloroform and ether. Usually alcohol is added, as in the well-known A.C.E. mixture, or is present as a preservative in the chloroform used, and so enables the two bodies, chloroform and ether, to mix.

Such casualties have occurred in Australia, Canada, England, Ireland, United States.

In the large majority of cases the pulse was noted as having failed before respiration; once only did respiration stop first, and in two cases the two ceased simultaneously.

The operations in course of performance were some trivial, some severe; but it seems unnecessary to specify them, as the records of the cases given below are few in number.

With the exception that vomiting twice complicated the case, no circumstances are recorded which would point to any predisposing cause for syncope or danger under the anæsthetic.

The Causes assigned for death are: Asphyxia from entrance of vomit into windpipe; "paralysis of heart" occurring in an alcoholic; respiratory failure due to pulmonary phthisis; "to fear before the operation"; shock, the result of imperfect anæsthesia.

The prevailing method of administration appears to have been dropping the mixture either upon lint or upon a napkin.

Post-mortem examinations:—

1. Congestion of lungs.
2. Phthisis.
3. Atheroma of aorta—adherent pleuræ.

DEATHS FROM MIXTURES OF CHLOROFORM AND ETHER.

- 1.—Female, aged 40. Ligaturing radial artery. Ether (2 parts) and chloroform (1 part) 3 dr. (sponge). Pulse failed first. Pulse ceased, respiration ceasing very shortly afterwards. Galvanic battery and artificial respiration; also brandy enemata; these endeavours kept up for 1 hour, tongue was pulled out.¹ The cause assigned for death was paralysis of fatty heart. Post mortem: Lungs; bronchitic inflammation with mucus in bronchial tubes, slight emphysema. Heart small, some fatty degeneration. Liver and kidneys soft and fatty. No condition of disease sufficient to endanger life, yet no organ thoroughly sound.
- 2.—Female, adult. Extraction of tooth. Ether 60 per cent. and chloroform 40 per cent. 2-4 dr. Anæsthetic given by a dentist. Died from breathing chloroform. Post mortem: Neither ether nor chloroform detected by analysis in liver, spleen, and kidney, or in the blood.
- 3.—Male, aged 33. Amputation of finger for gangrene. Ether and chloroform (towel held square). Pulse failed first; while breathing still good. Cold affusion on face, breathing became laboured, and then ceased. No return of pulse. Every possible means of resuscitation used with no effect. "Paralysis of heart," was addicted to liquor, the cause assigned for death.
- 4.—Male. Removal of crushed finger. Ether and chloroform. Respiration probably failed first. While under operation the patient suddenly gave two deep inspirations, when breathing suddenly ceased. Cause assigned for death was syncope.
- 5.—Male. Tracheotomy for removal of multiple tumours from larynx. Chloroform and ether. Pulse failed first. Pulse suddenly stopped, respiration ceased; lips and face turned blue. Application of air, ammonia, and artificial respiration ineffectual; tracheotomy performed quickly, and artificial respiration kept up $\frac{1}{2}$ hour; galvanism also applied with no avail.
- 6.—Male, aged 10. Straightening knee-joint. Chloroform and ether. Operation half performed when patient rose, vomited freely, lay down, and died in 10 minutes, in spite of all efforts to resuscitate him. No post-mortem. Heart and lungs considered normal as far as could be discovered.
- 7.—Female. Extraction of tooth ($\frac{1}{4}$ minute). Mixture of two-thirds chloroform and two-thirds ether. Four dr. used. Pulse and respiration failed together. The pulse failed and respiration

ceased without asphyxial symptoms. Was not fully anæsthetised. After tooth had been extracted became hysterical, then rigid, with dilated pupils. Measures resorted to were: Rubbing, application of strong ammonia, artificial respiration. Post mortem: Heart walls of aorta thin, otherwise healthy. Lungs: Posterior dependent portions quite dark; in upper lobes of both were smaller cheesy nodules. Had taken chloroform, ether and gas several times before, both severally and in combination. Both ether and chloroform tested and found pure.

- 8.—Male, aged 13. Straightening leg flexed at right angle (division of hamstrings). Chloroform and ether. Tendons having been divided and anæsthetic discontinued, the leg was extended, but directly after the countenance changed. Ammonia was applied to the nostrils, and the patient was inverted, with no result; he gave a gasp and died. "Shock rather than anæsthetic." Sudden extension of tissues at back of leg and sudden rupturing of adhesions in knee-joint may have produced quite enough pain and shock to account for death, unless the brain entirely paralysed, which was doubtful. These remarks apply to case in which death took place under chloroform given for same operation.¹
- 9.—Male, aged 8. Removal of two molar teeth. Chloroform and ether (chloroform more than 3 gr., ether freely used), two napkins used in succession. Pulse and respiration failed together. After operation, patient became partly conscious, and endeavoured to get rid of some blood from his mouth. A shadow passed over face, which became livid. Pulse and breathing stopped. Efforts to restore animation fruitless. Syncope was the cause assigned for death. Patient healthy and well-nourished, but timid. Chloroform was from a first-rate maker's.
- 10.—Removal of nail of great toe. Chloroform and ether (on lint). Pulse failed first. When the operation was completed pulse had ceased, and all efforts to restore animation failed. Cause assigned for death, syncope.
- 11.—Male. Amputation of great toe. Chloroform and ether. The pulse probably failed first. At no time of operation was patient thoroughly under the influence of the anæsthetic. At conclusion his breathing was natural. Suddenly gave a gasping sigh and expired. Pulse. Syncope was said to be the actual cause of death. Examination of patient gave no reason to suspect any visceral disease.
- 12.—Female, aged 45. Examination of abdomen. Chloroform and ether. Respiration. Breathing failed, face livid. Post mortem: Tubercular peritonitis. Phthisis at right apex of lung. Heart healthy.
- 13.—Male, aged 38. Removal of cancer of tongue. Chloroform and ether. Respiration failed first. Shortly after commencement of administration slight duskiness noticed and respiration ceased. Artificial respiration and inversion tried in vain. Soon after artificial respiration begun, shallow respiration made with spasmodic twitching of lower jaw. Post mortem: Slight atheromatous change at commencement of aorta. Lungs slightly adherent posteriorly. Liver enlarged and fatty. Of alcoholic antecedents. Was afraid of anæsthetic especially and operation. Thought his heart unsound. Examination of heart showed nothing unusual, except rapidity of action.
- 14.—Female, aged 28. Ovariectomy. Chloroform and ether. Given by a house surgeon. Respiration failed first. Respiration ceased when the abdomen was flushed with water, which was probably rather cold. Very weak.
- 15.—Male, aged 68. Hernia (strangulated umbilical, huge) ($\frac{1}{2}$ hour). Ether and chloroform (4 to 1 parts) (Clover's smaller apparatus). Pulse failed first. After failure of heart respiration lasted some little time. Failure of heart. No post-mortem; but heart suspected to be dilated and very feeble. Exceptionally fat (17 stone), only 5 ft. 6 in. in height.

DEATH REMOTELY DUE TO THE ADMINISTRATION OF ANÆSTHETIC.

Female, aged 53. Colotomy for obstruction of bowel. Chloroform and ether. One of resident medical officers gave the anæsthetic. After patient had been inhaling for two or three minutes began to vomit, then suddenly appeared to be choking, and ceased to breathe. Usual methods without success. Asphyxia. No post-mortem particulars. Stercoraceous vomiting occurred three days after admission to hospital.

¹ See Med. Times and Gazette, Oct. 6th, 1866, p. 437.

THE A.C.E. MIXTURE.

In the few cases recorded which, from references in current literature, we may assume do not represent the true mortality under this mixture, no especial analysis seems called for.

- 1.—Female, aged 32. Exploratory incision into right loin for kidney disease. Pulse failed before respiration. Suddenly the heart failed, and death ensued. Syncope, no sign of asphyxia. Post mortem: Both kidneys full of abscesses. No organic disease of heart. Death due in large measure to exhausted condition of patient. Patient suffered from hectic fever and profuse purulent discharge from urinary passages.
- 2.—Female. Forcefully straightening the knees. A.C.E. given in two doses. As patient was recovering from A.C.E. attention was called to her condition. As failure of heart's action feared, nitrite of amyl and strong ammonia applied to nose and cold applications to forehead. Artificial respiration kept up $\frac{1}{2}$ hour. Operation was finished. Syncope. In very bad health, had not been able to walk for five years. Had ulcers on her legs and stiffness of knees, for which operation was being performed on this occasion. No second medical man was present at the time of the accident.
- 3.—Male. For skin disease (lupus). The respiration appeared to fail first. Died suddenly during administration. Asphyxia. The patient was a heavy drinker.
- 4.—Male, aged 50. Opening fistula in ano (a few seconds). A.C.E. given on cone. Respiration failed first and quite suddenly. Died on the first cut being made.

Untoward cases: The methods of giving the anæsthetic were;—a cone, folded lint, or on a towel.

In one case the patient was anæmic, in another the heart was dilated.

Respiration appears in the majority of cases to have given out before the heart.

Series B.

- 1.—Male, aged 72. Enucleation of eyeball. Pulse and respiration failed together. Before becoming fully anæsthetised he stopped breathing; pulse ceased. Artificial respiration and galvanic battery. Patient rallied, but operation had to be abandoned. Was suffering from senile dementia. Had enlarged heart and chronic Bright's disease.
- 2.—Respiration failed first. Artificial respiration.
- 3.—No particulars.
- 4.—Male, aged 12. Respiration failed first. Respiration ceased completely; pulse good; pupils not dilated; no change in colour. A.C.E. was carefully administered 4 days after chloroform. (See Chloroform Cases.)
- 5.—Male. Iridectomy on both eyes. Alcohol, ether, chloroform. Pulse and respiration failed together. Became suddenly pale, deeply insensible; pulse and respiration very defective. Lint with a few drops of nitrite of amyl placed over mouth, then deep inspirations, flushed face, quick pulse, and return of sensibility. Patient, young man, hydrocephalic, inherited syphilis.

Series C, II.—Cases occurring in Private Practice.

- 1.—Male. For wound of scrotum. Respiration failed first (in 2 minutes).
- 2.—Female, aged 65. Vascular growth of urethra (5 minutes). A.C.E. given in a cone. Pulse failed first; pulse became flickering; respiration unimpeded. Tongue drawn well out of mouth; hypodermic of ether and brandy; artificial respiration. Patient had dilated heart; was very ill after the anæsthetic; the operation had to be given up. The operation had not been commenced when the heart failed.
- 3.—Female, aged 32. Hæmorrhoids. A.C.E. (cone). Pulse failed first. As the finger was stretching the sphincter pulse failed; the lips became very pale. Hypodermic of brandy was given, but without result. Patient was much blanched from loss of blood; operation was put off.
- 4.—A.C.E. (towel over frame). Asphyxiated. Artificial respiration; pulling forward tongue; lowering head, and raising arms and feet; successful.

UNTOWARD CASES OCCURRING WHEN CHLOROFORM MIXED WITH ETHER WAS GIVEN.

The following cases, although of great interest, are too few to require any special mention or survey in detail; we will, therefore, simply present them as they appear in summary:—

- 1.—One case recorded. Chloroform and ether. Respiration and pulse failed together. After two inspirations pulse stopped beating, and respiration entirely ceased. Artificial respiration kept up and strong ammonia given.

2.—Female, aged 55. Ether and chloroform given on two separate occasions. Showed untoward signs on first, and became collapsed on second occasion very seriously. Not given for long on either occasion, but on second only fully recovered after twelve hours' careful attention.¹

3.—Female, aged 34. Midwifery: forceps. Half-hour. Chloroform and ether (folded napkin). Respiration failed before the pulse.

4.—Male, aged 12. Anchylosis of the right knee-joint. Chloral, chloroform, 7 gr. chloral; (Esmarch's mask); 15 gr. later (Junker's apparatus). Tumour at knee-joint also found; while this was being examined patient gave cries of pain which showed narcosis not to have been very deep. Suddenly heart stopped together with respiration. Battery applied to phrenic nerve; pulse became fuller, and patient began to respire, and cried out. Administration of chloroform stopped when untoward symptoms came on. During the preparations for applying the apparatus for stretching the limb pulse and respiration suddenly stopped again. Measures adopted were: Renewed application of battery to phrenic nerve, insufflation down windpipe, artificial respiration for $\frac{1}{2}$ hour by the various methods—with no avail. Post mortem: Heart: Left ventricle contracted; full of thin fluid blood; no fatty degeneration or coagulation; Lungs: Left lung, red colour, but at top caseous mass size of bean. Right lung paler than left, adherent. Examination of heart and other organs revealed nothing abnormal. Chloral, chloroform had a very small quantity of alcohol added.

5.—4 cases. Cfr. *Charité Annalen*, Jhg. XI.

6.—Male, aged 15. Circumcision. Chloroform 2 dr. A.C.E. (Skinner's inhaler). Pulse and respiration failed together. At first touch of knife patient raised hands, as if conscious. Pupils dilated enormously. Face became congested; upper limbs in chronic spasm, like in epilepsy. In 15 seconds pulse and respiration failed completely. Measures adopted were: Subcutaneous injection of ether; nitrite of amyl; cold affusion; artificial respiration (when this employed pupils would contract), and galvanic battery. Syncope was the cause assigned for death.

7.—Male, aged 14. Rectifying spontaneous laxation in left hip-joint. Chloroform, ether, alcohol in the proportion of 100:30:30.

8.—Female. Incision of breast for mammary abscess. Chloroform 8 pts., spirits of turpentine 1 pt. Pulse and respiration failed together. Sudden spasm; pallor; difficulty of breathing; cessation of pulse. Every effort persisted in to restore animation. Syncope was the cause assigned for death. Post-mortem appearances *nil*. Had shortly before been anæsthetised by similar agent, but containing more turpentine.

CHLOROFORM FOLLOWED BY OTHER ANÆSTHETICS.

Deaths in cases in which chloroform was given at first, and the anæsthesia was maintained by the use of ether.

It will readily be seen that these cases are very different from those in which the two anæsthetics were exhibited, combined as a mixture. In the last case the physiological effect produced is somewhat that of chloroform, while when chloroform is given first, and is followed by the use of ether, the physiological effects of which, in some ways, are antagonistic of these two substances, appear in succession. Thus the depression which many observers have referred to as following the use of chloroform would, when ether was given, be replaced by a stimulating effect, one which might, it is believed, prove highly detrimental when the circulatory system was severely taxed and unable to respond to any sudden stimulation.

The deaths have occurred in individuals between the ages of 21 and 48, and are reported from England and the United States.

In the large majority of cases the pulse failed before respiration.

The operations being performed at the time of the fatalities were of no unusual kind.

No predisposing or complicating conditions existed in these cases.

The Causes assigned for Death were: Asphyxia; "failure of respiration"; syncope.

The Methods of Administration were: Chloroform given on lint, followed by ether given in a felt cone; flannel cap for chloroform, followed by Clover's ether inhaler; chloroform given, but method not named, followed by ether from an Ormsby's inhaler.

Measures adopted for resuscitation were: Artificial respiration; electric stimulation by faradic, by galvanic currents; inversion; laryngotomy; stimulants, external cold affusion, flagellation with wet towel; "mechanical stimulation of the heart"; injection of ether hypodermically; rectal injection of brandy; drawing forward of the tongue.

¹ See *Brit. Med. Journ.*, Nov. 11th, 1876, p. 627.

Post-mortem examinations :

1. Heart dilated, fatty, valves diseased, aorta and other arteries badly atheromatous, lungs engorged with blood.
2. Heart and vessels diseased (fatty, atheromatous); valves thickened, incompetent.
3. Do. do., aortic incompetence. Kidneys fatty.
4. Heart fatty, valves diseased, kidneys contracted.

A case is appended which seems to be one in which the death was only remotely the result of the anæsthetic.

(a.)—DEATHS FROM CHLOROFORM FOLLOWED BY ETHER.

1. Female, aged 45. Removal of fatty tumour from back (5 minutes). Chloroform 1 dr. (lint), then ether (sponge in felt cone). Pulse failed first. Pulse became irregular. Ether then given. Pulse became regular and fuller for a few seconds, then stopped suddenly. Respiration then ceased; face became a dusky red. Measures resorted to were: Drawing forward tongue and artificial respiration for $\frac{1}{2}$ hour; at same time galvanism, one pole over left clavicle, other over heart and at epigastrium. Chest struck with wet towel and brandy injection (4 oz.) per rectum. All these means failed to re-establish action of heart. Syncope. Post mortem: Lungs gorged with blood. Pericardium covered with layer of fat and containing small quantity of fluid. Heart covered with layer of fat; ventricles dilated, containing little fluid blood; valves atheromatous but competent; pulmonary artery and aorta with patches of atheroma. Patient fat; pulse regular, heart sounds normal, rather feeble.
- 2.—Female, aged 21. Amputation of right leg above ankle. Chloroform (3 or 4 minutes); ether (2 or 3 minutes). Chloroform 2 dr. (on lint), followed by ether (on sponge in felt cone) 2 oz. Pulse failed first. Became blue in face and pulseless at wrist; lips white and heart's action not felt. Measures resorted to were: Artificial respiration, removal of bandage from limb; cold affusion; flipping with wet towels; application of interrupted current to pericardium. Heart never beat again. Pupils contracted throughout attempts at resuscitation. Patient moribund 2 minutes after ether was begun. Syncope. Post mortem: Heart: friction patches, no pericarditis; wall of right ventricle thin, of left thick; mitral valves thickened; at junction of anterior cusp of mitral valve with wall of ventricle was small ulcerated patch; aortic valves thickened; two decoloured clots in left ventricle, commencing atheroma of aorta. In right kidney remains of small impacted embolus. Clot in femoral and popliteal artery. Had had rheumatic fever, suffering great pain owing to commencing gangrene of foot due to embolism of popliteal artery. Some thought a mitral *bruit* could be heard on auscultation.
- 3.—Male, aged 26. For irreducible inguinal hernia. Chloroform followed by ether. Respiration failed first. Respiration became noisy and laboured, and patient turned very cyanotic. Tongue dragged out, and colour and breathing improved till end of operation, but though no further dose given, he relapsed again. Measures employed were: Artificial respiration, and then laryngotomy, but both useless. Pulse good till end. Asphyxia. Post mortem: Kidneys large and fatty; liver fatty. Aortic valves dilated, and probably incompetent, but no degeneration of heart-muscle. Patient very stout (20 stone nearly), with double aortic murmur. As hernia was source of serious risk, operation determined on after due consultation.
- 4.—Female. For diagnostic purposes. Chloroform followed by ether. Died from the influence of the anæsthetic. Had suffered for 2 years from symptoms probably due to a uterine polypus, which was removed.
- 5.—Female, aged 48. Removal of scirrhus tumour of left breast. Chloroform (2 or 3 minutes); ether (1 minute). Chloroform (open inhaler), followed by ether (Ormsby's inhaler). Pulse failed first. Slight change in colour. Became blue in face; pulse ceased to be perceptible, but respiration lasted a minute. Measures adopted were: Inversion; mechanical stimulation of heart; galvanism; ether injection. Artificial respiration kept up $\frac{1}{2}$ hour. Syncope. Post mortem: fatty heart and granular kidneys. Felt great alarm at prospect of operation. Heart carefully auscultated; pulse regular, and no suspicious sounds.
- 6.—Female, aged 30. On vesico-vaginal fistula. Chloroform (a little), followed by ether (Clover's inhaler) 2 oz. Pulse failed first, and mucous membrane of lips seemed blanched. Respiration shallow and infrequent, and pulse ceased. Artificial respiration carried on some time, and means used to stimulate heart, but patient did not rally. Syncope. Post mortem: Heart: All valves, except pulmonary, diseased. Kidneys contracted, granular. Death, therefore, considered due to embarrassment of weak and diseased heart by reason of position during long operation, combined with effect of ether-vapour on lungs.

DEATH REMOTELY DUE TO ADMINISTRATION OF ANÆSTHETIC.

- 1.—Male, aged 25. Amputation for compound fracture of right leg. Chloroform followed by ether. Stomach full of food; vomit followed by deep inspiration; trachea and larynx filled with half-digested food, so that even tracheotomy did not restore power of breathing. Asphyxia.

- 2.—Female, aged 46. Senile cataract (1 minute). Chloroform followed by ether. Respiration shallow, but there was struggling. Pulse feeble, not intermittent. Slight lividity of cheeks and forehead. Chloroform removed and ether given. Other means for restoring circulation were tried, but in vain. Post mortem: Heart flaccid, empty; mitral valve contracted, aortic valve incompetent. Kidneys fatty and granular. Extremely fat and of slow intelligence. Had shortness of breath, but not known to suffer from organic disease.
- 3.—Male, aged 15. High amputation of thigh. Chloroform followed by ether. Given by the house surgeon. Pulse failed before respiration. The only symptom detailed was sudden stopping of the pulse. The cause of death was cardiac failure. Patient was sinking from profuse suppuration.

UNTOWARD CASES.

- 1.—Female, aged 10. Removal of scar and suppurating strumous gland (4 minutes chloroform, 20 minutes ether). Chloroform followed by ether (American-gridiron-inhaler). Breathing slow, face pallid, pulse became worse and worse. Fresh air admitted to room; hot brandy-and-water given in teaspoonful every 3 or 4 minutes, which restored pulse, patient at length taking it voluntarily.
- 2.—Male, aged 57. For operation for disorganisation of metatarsal phalangeal joint of great toe of left foot. Chloroform (Skinner's inhaler) followed by ether. Given by a house-surgeon. Respiration failed before the heart. Patient was got under without much struggling and operation was about to commence when house-surgeon noticed that respiration had ceased. The pulsation in the femoral was then found to have ceased. The head was depressed and tongue drawn out, and artificial respiration (Silvester's method) maintained about 28 to the minute. This was continued about 4 minutes, no pulse at femorals being apparent. Four drops of nitrite of amyl from a capsule freshly broken on lint applied to patient's nose. Colour in patient's face and pulse at femorals returned almost immediately and operation was continued under ether. History of three distinct attacks of gout.

(b.)—UNTOWARD CASES; NO FATALITIES ARE RECORDED WITH THIS SUCCESSION; CHLOROFORM FOLLOWED BY A.C.E.

- 1.—Male, aged over 70. Gastrotomy for impassable œsophageal stricture. Chloroform (lint) followed by A.C.E. (lint). Under chloroform pulse so irregular that operation was discontinued. A.C.E. substituted for chloroform and operation successfully completed.
- 2.—Male. Ligature of femoral for inflamed aneurysm of popliteal (over 1 hour). Chloroform (lint) followed by A.C.E. (lint). Under chloroform pulse so irregular that operation was discontinued. A.C.E. substituted for chloroform and operation successfully completed.

(c.)—DEATHS; ETHER FOLLOWED BY CHLOROFORM.

- 1.—Male. Dressing injury to thumb. Ether first, chloroform substituted, small quantity. After a few inspirations patient died. Syncope. Post mortem: Fatty degeneration of heart, with valvular disease. Weakly, with organic disease; had been invalid for several years.
- 2.—Female. Removal of large cancer mass from right breast (20 minutes). Ether substituted by chloroform. At close of operation, sudden lividity. Tongue drawn well forward and artificial respiration. Patient died in about 3 minutes. Breathing never became stertorous. Syncope. Patient fairly nourished, nervous temperament, no indication of cardiac disease.
- 3.—Male. Aged 60. Removal of tumour from lower jaw. Ether followed by chloroform (Clover's inhaler); 1 gr. morphine given before ether subcutaneously. When operation completed patient had good pulse; respiration slow; pupils contracted to pin's-point; profuse sweating. Two hours later no consciousness. Died with symptoms of narcotic poisoning. Post-mortem appearances nil.
- 4.—Male, aged 30. Stretching sciatic nerve for sciatica. Ether followed by chloroform (Clover's inhaler). Pulse and respiration failed together. On being given ether the patient struggled violently; chloroform then given, and almost at once he turned pale and both pulse and respiration ceased. Artificial respiration kept up half-hour in vain; as last resource heart punctured and aspirated. Operation never begun. Death probably due to syncope possibly induced by violent efforts of patient under ether.
- 5.—Male, aged 19. Removal of necrosed bone from leg. Ether, afterwards (at patient's desire) chloroform. At commencement of operation became pallid and heart's action could not be felt. Under prompt measures cardiac and respiratory restoration occurred, but stopped after 3 or 4 minutes in spite of artificial respiration for half-hour. "Syncope produced by action of chloroform-vapour upon heart."

(d.)—DEATHS; ETHER FOLLOWED BY ETHER AND CHLOROFORM.

- 1.—Female, aged 28. For abscess in throat (abscess caused by pin being lodged in throat). Ether, followed by ether and chloroform. Respiration failed first. Ether first given, but as patient

took it badly, none given for 1 hour. Then ether given and some chloroform. Breathing became bad. Patient laid on floor; artificial respiration and galvanism used, which partially restored pulse and respiration, also enemata of brandy, milk and eggs given, and warm bottles applied. Patient rallied, but died next day. Inflammation of lungs accelerated by chloroform. Post mortem: Bases of lungs showed signs of recent pleurisy. Left lung pneumonic, breaking down in ragged, sloughy patches. Mucous membrane about epiglottis and upper part of pharynx inflamed. Chloroform given against wish of patient, as she stated before her death. Before her death she was for some time delirious.

- 2.—Female, aged 45. Examination of uterus for large uterine polypus (10 minutes about). In 3 doses (1) ether; (2) ether and chloroform; (3) chloroform (2 dr. chloroform used). Pulse failed first. Breathing suddenly loudly stertorous, face cyanotic, and pulse at wrist ceased, pupils being slightly dilated. Tongue was drawn well out of mouth, flipping face and body with cold water, and artificial respiration at once begun, which latter was kept up for 1 hour. Patient rallied for brief period, but sounds of heart could not be detected. Right external jugular vein prominent, and was opened, blood flowing in jet at once. Galvanism to heart, enema of brandy, turning body on side (Silvester's method) and raising trunk with head low, all tried. Post mortem: Much fat in anterior mediastinum. Pericardium normal. Muscular fibres of right ventricle hidden by deposit of fat. Left ventricle empty; right contained no clots; blood quite liquid. Mitral valve with small circular patch of induration; 4 to 6 bead-like bodies of lymph on central aortic valve. Heart 14 oz. Microscopically, fatty infiltration of muscular fibres, but no fatty degeneration of fibres. Polypus (size of child's head) attached by pedicle to fundus of uterus. Cysts in right ovary. Cessation of catamenia, followed by uterine hæmorrhage, at intervals of 2 to 6 weeks, for 2 years; anæmic appearance. Had lost flesh about a month (Dec. 25, 1879-Jan. 24, 1880).
- 3.—Male, aged 37. Blind fistula. Ether followed by chloroform. Pulse and respiration failed together. Simultaneous failure of pulse and respiration; face livid. Dorsal decubitus; artificial respiration; struck with wet towel; nitrite of amyl; tongue pulled forward. Patient was first anaesthetised with ether, which he took for 10 minutes from a Clover's inhaler, and showed no untoward symptoms. He was then turned on his left side, and given chloroform on folded square lint, covered with green protective (oil silk), 1 dr. being used. In 10 minutes more another 1 dr. was given, and the incision made. Patient seemed to shudder, and pulse and respiration stopped.

UNTOWARD CASES OCCURRING WHEN ETHER WAS GIVEN, AND WAS FOLLOWED BY SOME OTHER ANÆSTHETIC.

SERIES B.

Female, adult. Plastic operation in perineal region. (1) Chloroform, (2) ether, (3) chloroform and ether. (1) Inhaler, (2) handkerchief. Pulse wavered and stopped; restored by cold affusions. Pulse again stopped, and face became cold. Tongue drawn out; ammonia applied to nostrils, artificial respiration (Silvester's method). All these failing, faradisation tried. Gradual breathing, and then pulse restored.

UNTOWARD CASES, OCCURRING DURING THE ADMINISTRATION OF ETHER, FOLLOWED BY CHLOROFORM.

SERIES B.

- 1.—Male, aged 62. Radical operation for inguinal hernia. Ether followed by chloroform. Spasmodic coughing with cyanosis, in spite of hypodermic of morphine. Coughing rendered operation impossible under ether. Chloroform substituted, and operation satisfactorily concluded.
- 2.—Aged 26. Incision of relapsing perityphilitic stercoraceous abscess (ether 20 minutes). Ether (Ormsby's inhaler) followed by chloroform. Neither tolerance nor relaxation induced. Change to chloroform produced desired state, and operation performed.
- 3.—Aged 39. For laryngo-fissure for removal of endo-laryngeal tumours. Ether followed by chloroform. Alarming spasm of glottis with cyanosis, and imminent suffocation. Chloroform given, resulting in pleasant and undisturbed anæsthesia; tumours removed.

UNTOWARD CASES UNDER A MIXTURE OF ETHER AND CHLOROFORM FOLLOWED BY ETHER.

- 1.—Male, young adult. Operation on eye. (1) Ether and chloroform (sponge); (2) chloroform (towel). Pulse and respiration failed together. After ether and chloroform had been given, respiration and pulse failed, but as speedy recovery took place operation was proceeded with, but patient was too restless to allow of it. Chloroform (pure) then given, and eyeball removed. Suddenly bleeding ceased, became white, lips blue and pallid, pupil of remaining eye dilated. Pulse and breathing stopped. Artificial respiration and heating with wet towel persisted in to great length. At last, livid hue turned to red; this followed by slight gasp; still further efforts, and patient breathed and pulse came. Healthy and active young farmer. One eye destroyed by injury; it was acutely inflamed, hopelessly lost, and affecting the other. Made perfect recovery. A third medical man was present helping, otherwise patient's life would probably not have been saved.

- 2.—Ether (Clover's inhaler), chloroform (lint). Respiration failed first. Several times has seen respiration stop, but resort to artificial respiration has rallied patient. Attributes this to allowing the patient partly to recover and then suddenly giving a lot of chloroform.
- 3.—Jaws (excision of) (under 20 minutes). Ether, morphia.
- 4.—Removal of lymphadenomatous glands from right of neck (40 minutes). (1) A.C.E. given on lint, followed by (2) chloroform given on lint, followed again by (3) A.C.E. given on lint. Pulse and respiration failed together. A.C.E. first given, but oozing of blood occurred; then chloroform given; but on patient turning blue, A.C.E. readministered. After 40 minutes patient became quite white, pulse and respiration both failing. Injection of ether; this followed by semi-inversion and artificial respiration; further injections of ether. Patient fairly recovered in 2 minutes.
- 5.—Male, aged 25. Excision of knee-joint for tuberculous caries. Chloroform, ether, and alcohol (Billroth's mixture), i.e., chloroform, 3 parts; ether and alcohol, each 1 part (50 grammes). Symptoms of imminent asphyxia came on quite suddenly. Artificial respiration (Silvester's method); recovery after 10 minutes. Patient otherwise healthy.

(c.)—DEATH FROM METHYLENE AND ETHER.

Female, aged 62. Ovariectomy. Methylene and ether (on single fold of towel). Pulse failed before the respiration. Pulse suddenly stopped, pupils became dilated. Respiration ceased. All efforts at restoration useless. Artificial respiration (Silvester's method); ammonia, slapping chest, and cold affusions tried. Inhalation of methylene and ether, causing syncope. Post-mortem did not reveal cause of death; all organs healthy except ovary. "The systolic murmur must have been hæmic." During life a systolic murmur at base of heart had been detected.

(f.)—DEATH FROM METHYLENE FOLLOWED BY ETHER (METHYLATED), FOLLOWED BY METHYLENE.

Male, aged 56. Removal of diseased bone from leg. In 3 doses: (1) Bichl. methylene, (2) ether (methylated), (3) bichl. methylene. During last dose patient struggled greatly; then had epileptiform convulsion, followed by tonic spasm; this relaxed, breathing became stertorous; pulse failed. (?) Syncope. No post-mortem allowed. It was thought that the convulsion might have been caused by cerebral hæmorrhage.

(g.)—DEATH REMOTELY OCCURRING FROM NITROUS OXIDE AND ETHER.

- 1.—Female, aged 55. For strangulated femoral hernia. Well under in 4 minutes. Nitrous oxide and ether (Clover's apparatus). Pulse and respiration failed together. Went well under in about 4 minutes, without previous excitement. Taxis was then applied, when almost immediately patient became pale and recommenced vomiting stercoraceous matter. Respiration became weak and pulse imperceptible. Air admitted and artificial respiration done. Enema of brandy, 3 oz. given. Strong ammonia applied to nostril and ammonia injected into right median basilic vein. Patient died in about 10 minutes from commencement of alarming symptoms. Post mortem: Stercoraceous matter found in trachea and right bronchus. Right side of heart and large veins full of dark fluid blood. Ventricular walls thin and flabby, cavities slightly dilated. Left ventricle empty. Atheromatous patches on arch of aorta.
- 2.—Female, aged 21. Gas followed by ether. Respiration and pulse failed together. Respiration and pulse stopped soon after commencement of administration. Post mortem: Pleuritic effusion on right side, with displacement of heart to left. Large hydatid cysts of liver and uterus, and suppurated and dilatation of ureters. Very anæmic; weak pulse.
- 3.—Female, aged 43. Removal of sloughing fibroid uterus. Nitrous oxide, then ether; less than ½ oz. (Clover's inhaler). Respiration failed first. Operation over and ether discontinued. Respiration noticed to be failing, and it grew feebler. Artificial respiration of no avail. Pulse gradually failed, and ceased in 7 minutes. Some cyanosis. Brandy also given per rectum. Post-mortem 4 days after death. Old pleural adhesions, and no other gross lesions. Had taken nitrous oxide and ether 2 days previously.
- 4.—Male, aged 54. Lumbar colotomy. Nitrous oxide and ether. Heart: Moribund at time of operation.

UNTOWARD CASE; NITROUS OXIDE FOLLOWED BY ETHER.

For carcinomatous infiltration of right nostril. Nitrous oxide and ether. Respiration failed first. Sudden asphyxia arose, which ceased after a few chest compressions. Ether inhalation begun again, and fatal results seemed impending. Tracheotomy restored patient, to all appearances dead.

(h.)—DEATH; BROMIDE OF ETHYL AND CHLOROFORM.

Female. Dental. Bromide of ethyl (1 oz.) with chloroform (4 or 5 drops). Patient recovered completely from effects of anæsthetic, and felt quite well during remainder of day. Next day, however, she died. Dentist charged in court with causing death of patient. A commission of medical experts directed to report upon the matter.

PART VIII.—THE CONCLUSION OF THE COMMISSION.

THE report of the clinical records has now come to a close so far as the mere statement of facts is concerned. It remains to indicate as succinctly as possible the conclusions which a careful study of the very large amount of evidence appears to warrant. The chief interest naturally centres in the facts as regard chloroform and ether, since although much may well be said about nitrous oxide, the various mixtures and other anæsthetics, yet their use in general surgery is comparatively small, and there appears to be no indication why it should in the future be extended.

The higher death-rate shown by our observations to be associated with the use of chloroform has to be looked at from various points of view before a just idea of its real significance can be obtained. The returns given in the tables which supply the number of times the various anæsthetics are used show that chloroform was employed some six times more frequently than ether. Unfortunately these figures are only approximately accurate, since no returns have reached us from the large London hospitals in which ether is so much employed, while they comprise returns from some parts of Scotland and from abroad, places where chloroform is used almost exclusively. An examination of the record of private practice indicates further that chloroform is used more frequently in that department of practice than is any other anæsthetic.

In hospital practice, then, a considerable number of chloroform deaths (say 6 to 1, although this is doubtless too favourable to chloroform) in excess of those under ether might only represent an equal mortality, the deaths being taken in relation with the actual number of times the anæsthetic is given. Again, the deaths recorded prior to 1864 are practically all from chloroform, as ether was but little employed in this country up to that date, so that until subsequently to that date no basis of comparison exists between the two anæsthetics. Taking, then, the figures of deaths between 1864 and 1892, exclusively, we have 596 deaths under chloroform and 45 under ether, a proportion of 13 to 1—a mortality under chloroform at least double that under ether¹—assuming, that is, that the 596 deaths under chloroform occurred in double the number of administrations of chloroform as compared with ether. To put it more clearly, it is assumed that for every 100 patients who take ether 200 take chloroform. To compare deaths under these two anæsthetics it would under this assumption be necessary in the case of chloroform to divide the actual number by two.

A similar result follows investigation of the untoward cases. But it has to be remembered that it is asserted, although we have no evidence placed in our hands to show this, even in response to the special appeal of THE LANCET, that in Scotland an enormous number of administrations of chloroform is yearly made, while the casualties are few. Surgeon-Lieutenant-Colonel Lawrie's unique record of 45,000 cases of chloroform administrations without a death, with the statistics said to exist in Scotland, must tell greatly in favour of chloroform. Unhappily, the experience of these observers is not borne out by that of others. On the other hand, it must be remembered that the employment of ether has only become at all general quite within the past few years. We are not yet able to learn, for example, whether any one skilled observer² has been able to give ether to 45,000 persons without any fatality. Juilliard (Geneva) from a very large number of cases gives the

mortality under ether at one death in 14,987 administrations, which is undoubtedly a very favourable record for that anæsthetic, the same observer giving one death in 3257 administrations of chloroform—i.e., 4 deaths under chloroform to 1 under ether. On the other hand, it must be pointed out that our statistics do not include many cases of etherisation of normal healthy persons—the experience of the large London hospitals, for example—but does include a large number of cases of persons who were so feeble and exhausted that ether was given rather than chloroform, and almost as a last resource.

Consideration of the cases we have given certainly seems to justify the following conclusions: at least many of the deaths under all kinds of anæsthetics seem to be inevitable, and arise from the depreciated vitality of the patients, and appear not to be due specially to the anæsthetic. The operations in these cases were undertaken as a last resource, to give the individual, as it is said, every chance, and the stress of the anæsthetic, or a concurrent accident, such as the sucking into the windpipe of vomit when the patient was partly under the anæsthetic, gave the *coup de grâce*. Of these cases it can only be said that, the greatest care having been taken and an intelligent choice of the anæsthetic having been made, the medical man responsible for the administration has done his best, and if death results it is comparable to a patient succumbing to shock after the amputation of his thigh. Of course, the choice of an anæsthetic is in such cases a matter of grave responsibility, and to this we shall revert later. Of other deaths it is urged that although they are reported as occurring just at the commencement of the inhalation of chloroform, yet they are due to fright and not to the drug. Dr. Snow³ discusses this possible form of death, and cites cases which are certainly closely allied to some of those presented in this Report. Upon the other hand, it would appear that the chloroform might constitute a factor in this variety of casualty, as such accidents hardly ever, if, indeed, ever, occur when ether or nitrous oxide is given, a fact probably accounted for by the initially greater stimulation which these substances exert as compared with chloroform. Yet another class of cases falls into the category of preventable deaths—the fatality resulting from the inexperience of the administrator or his carelessness, or arising from the use of an impure drug or an improper apparatus. In some cases we find the chloroform administration confided to persons wholly devoid of medical training (*cf.* Case 280), such as workhouse attendants, domestic servants, &c.; in others to those whose training was incomplete, such as medical students and dentists (not possessing a medical qualification). In others special note is made that the chloroform was found to be impure, having undergone decomposition, or having been badly prepared.

Want of due precaution may in many of the cases have brought about a fatal result. Especially in dental operations the posture of the patient does not appear to have been duly considered, and the patient was permitted to sit rather than to assume the recumbent position. The non-insistence on abstinence from food for a sufficiently long time before the administration led in several cases to fatal results from the entrance of vomit into the air passages.

RELATIVE NUMBER OF DEATHS UNDER VARIOUS ANÆSTHETICS.

An attempt was made to ascertain what was the proportion of the deaths and untoward cases occurring under anæsthetics in relation to the frequency with which the various agents were employed. In the forms of inquiry sent out by

¹ Gurlt results, obtained from German practice, are: Chloroform, 1 death in 2574 administrations; ether, 1 death in 8433 administrations, a proportion of 1 ether death to 3·2 under chloroform.

² Ollier has, however, recorded 40,000 etherisations without a death (Archiv für Klinische Chirurgie, Band xli, p. 139, Berlin); Leon Tripiet, 6500 etherisations, with no death; and Poncet, 15,000 etherisations, with 2 deaths.

³ On Chloroform, pp. 77, 209-212.

THE LANCET questions bearing upon these points were asked, and although many of the larger hospitals, especially those in the chief centres, such as London, Edinburgh, gave but a very imperfect return of their anæsthetic work, a great number of answers were received.

In the records of 18 provincial hospitals 18 deaths are reported under chloroform and 4 under ether. The 4 deaths under ether took place in three institutions, and in two of those ether was used almost exclusively, while in the third it was employed somewhat more frequently than chloroform. One other death under ether is recorded in addition to the four above mentioned, which occurred when the patient, having taken chloroform, was subsequently given ether as an inhalation to restore animation. Two deaths are further recorded when admixture of chloroform and ether was given.

In the Reports we publish in the following London hospitals—Cancer, Charing-cross, Children's (Great Ormond-street), Children's (North-Eastern, Hackney-road), Dreadnought, Great Northern, Guy's, King's College, London, Lock, Metropolitan Free, Middlesex, Ophthalmic (Moorfields), Do. (Central London), Do. (South London), Do. (Westminster), Royal Free, St. Bartholomew's, St. George's, St. Mark's, St. Mary's, St. Peter's, St. Thomas's, Do. (Home), Samaritan, Seaman's (Greenwich), Surgical Home (Fitzroy-square), West London, Westminster, University College, and Victoria for Children—144 deaths occurred under chloroform and 17 under ether.

In other hospitals and infirmaries of England and Wales deaths under chloroform amounted to 125, and under ether to 8, viz., Aldershot, United Bath, Bayston Hill, Blackburn, Birkenhead, Birmingham, Bootle, Bradford, Brighton (Sussex County), Do. Infirmary, Bristol, Broadmoor, Cambridge, Canterbury, Carlisle, Cardiff, Chester, Cirencester, Croydon, Derby, Devonport, Dudley, Exeter, Exmouth, Gloucester, Hanwell, Huddersfield, Hull, Ipswich, Kidderminster, Leeds, Leicester, Lincoln, Liverpool, Maidstone, Manchester, Newcastle, Northallerton, Northampton, Nottingham, Oxford, Peterborough, Preston, Reading, Shrewsbury, St. Helens, Sheffield, Sunderland, Staffordshire, Sudbury, Swansea, Taunton, Tavistock, Warley, Wolverhampton, and York.

Scotland records 18 deaths under chloroform, and none under ether, viz., in Aberdeen, Alloa, Edinburgh, and Glasgow.

In the United States 18 deaths occurred under chloroform and 11 under ether in the following hospitals:—Chicago, Cook Co., Illinois, Louisville, New Jersey, New Orleans, New York, Philadelphia, San Francisco, and St. Louis.

Six deaths were reported from Berlin hospitals—4 under chloroform, 1 when ether was given by the rectum, and 1 when Billroth's mixture was given. One death under chloroform is reported from Toulouse, but in our collected cases we find 13 deaths under chloroform are recorded from France. In all, 322 deaths under chloroform and 37 under ether, giving a proportion of 8·7 of deaths under chloroform to 1 under ether.

NUMBER OF ADMINISTRATIONS OF VARIOUS ANÆSTHETICS

The importance of ascertaining the frequency with which the various anæsthetic agents are administered has been already insisted upon more than once in this Report, so that it will need no preliminary remarks to introduce the following statistics derived from various institutions throughout Great Britain, the Colonies, and abroad.

The first table (A) gives the number of times the various anæsthetics—chloroform, ether, the A.C.E. mixture, and others—have been employed in various institutions in England and Wales, the Continent, the Colonies, United States, &c. It will be seen that although THE LANCET sent inquiries to all the British hospitals and to the leading hospitals abroad, only a comparatively small number were able to furnish reliable statistics. As, however, the facts tell for or against the various anæsthetics equally, no selection having been attempted, it is believed that the numbers obtained are of great value and advance the inquiry of this Report to a material extent.

The first column gives the name of the hospital, and the second approximates the number of times chloroform has been given during the last ten years (ending 1891), the third the number of times ether has been given, and the fourth the number of times the A.C.E. mixture, while the remaining anæsthetics are dealt with in subsidiary tables. Surgeon-Lieutenant-Colonel Lawrie's cases, which he computes at 45,000 chloroform administrations, are not included in these

statistics, nor are the reputed several thousand successful ether administrations unmarked by a fatality of the London anæsthetists.

TABLE A.—HOSPITALS—NUMBER OF TIMES THE VARIOUS ANÆSTHETICS HAVE BEEN USED.

Name of hospital.	Chloroform.	Ether.	A.C.E.
Co. Antrim Infirmary	—	—	320
Akyab General Infirmary and General Hospital	150	—	—
Ashton-under-Lyne District Infirmary	259	7	9
Belfast Hospital for Sick Children	1000	—	—
St. Bartholomew's Hospital, Chatham Infirmary and Dispensary, Bolton	224	1392	—
Boston Lunatic Hospital	243	4	3
Bridport Cottage Hospital	—	100	—
Hospital for Sick Children, Brisbane, Queensland	400	—	—
General Hospital, Bristol	350	—	—
Dispensary Hospital, Bury, Lancs	8950	50	—
Cancer Hospital, London	420	30	—
Cardiff Infirmary, Cardiff	50	961	—
Derbyshire General Infirmary	252	316	—
Devon and Exeter Hospital, Exeter	125	589	22
Dewsbury and District General Infirmary	217	—	—
General Infirmary and Dispensary, Doncaster	245	11	11
Poo-chow Native Hospital	298	42	42
Infirmary, St. George's-in-the-East	800	—	—
St. George's Hospital, Fulham-road	15	25	—
Kentucky Institution for Education and Training of Feeble-minded children	50	50	—
Kidderminster Infirmary and Children's Hospital	4	—	—
Lancaster Infirmary	93	38	—
Leadbury Cottage Hospital	296	4	—
North Lonsdale Hospital	3	69	—
County Louth Infirmary	325	—	—
St. Luke's Home for the Sick, Richmond, Virginia, U.S.A.	120	60	80
Maine General Hospital, Portland, Maine	3000	200	—
Miller Hospital and Royal Kent Dispensary	—	2461	—
Milton Abbas Cottage Hospital	120	8	22
Montrose Royal Infirmary	2	—	—
Great Northern Central Hospital	1000	—	—
Naval Hospital, Chelsea, Mass.	257	—	—
North-Eastern Hospital for Children, Hackney-road, E.	5	95	—
North-West London Hospital, Kentish Town, N.W.	3135	7	—
Ophthalmic Hospital, Madras	864	96	—
Royal London Ophthalmic Hospital, Moorfields	4156	—	—
Poplar and Stepney Sick Asylum	825	1507	58
Rosecommon County Infirmary	300	—	—
Royal Cornwall Infirmary, Truro	285	—	10
Royal Infirmary, Glasgow:—	490	10	—
Dr. Cameron	200	—	—
Dr. Dunlop, Wards 15, 23, 24	3380	120	—
Dr. Knox, Wards 27, 23, 19	1700	50	—
Dr. Lethian, Wards 13, 14, and Burn Wards	155	2	—
Dr. Macewen, Wards 21, 22, 29	3600	—	—
Dr. Morton	500	—	—
Dr. Newman, Throat Ward	—	9	—
Dr. Stirton	450	50	—
Royston Hospital	—	—	—
Salisbury Infirmary	652	38	22
Salop Eye, Ear, and Throat Hospital	107	—	—
Samaritan Hospital for Women, Belfast	1240	—	—
St. Saviour's Union Infirmary, East Dulwich Grove, S.E.	127	30	—
Sheffield Children's Hospital	2150	50	—
State Insane Asylum, Howard, Rhode Island, U.S.A.	—	10	—
State Almshouse, Howard Royal Infirmary, U.S.A.	—	25	2
State Workhouse, Howard Royal Infirmary, U.S.A.	—	12	—
State Prison, Howard Royal Infirmary, U.S.A.	—	20	—
(State) Reform School, Howard Royal Infirmary, U.S.A.	—	13	—
Sussex County Hospital, Brighton	671	119	551
United States Marine Hospital, Boston, Mass., U.S.A.	28	202	—
Victoria Infirmary, Verdin Park, Northwich, Cheshire	—	2	—
Hospitals for Insane, Melbourne, Victoria:—	—	—	—
Hospital for the Insane, Sunbury, Victoria	1	—	—
Hospital for the Insane, Ararat, Victoria	4	—	—
Lunatic Asylum, Kew, Victoria	—	—	—
Yarra Bend Asylum	4	—	1

TABLE A—continued.			
Name of hospital.	Chloroform.	Ether.	A.C.E.
Village Hospital, Hambrook, near Bristol	10	40	—
West of England Eye Infirmary, Exeter	237	237	—
Western Kentucky Lunatic Asylum... ..	12	—	—
Westminster Hospital	48	165	—
Wirral Children's Hospital, Birkenhead	390	10	—
(Name not given)	442	262	—
Continental Hospitals:—			
Chirurg. Universitäts Klinik in Bonn	—	—	—
Chirurg. Universitäts Klinik in Bostock	—	—	—
und Johannes Hospital in Bonn... ..	—	—	—
Chirurgische Klinik in Krakau	4200	—	—
Königl. Chirurg. Poliklinik und Kngl. Universit. Kinderklinik	2000	—	—
Clinique Chirurgicale de l'école de Médecine de Toulouse	550	—	—
Chirurgische Universitäts Polyklinik in Berlin, Chir. Klinik in Giessen, Chir. Klinik in Zurich	12,500	—	—
Totals... ..	64,693	9380	1163

In Table AA is given a similar statement with regard to the less commonly used anæsthetics. In Table B are recorded the actual numbers of cases in which the various anæsthetics have been employed and reported to us. The table shows at a glance the relative frequency with which the various anæsthetics are used.

In considering Table B it must be remembered that many of the less well-known or less used anæsthetics are omitted by observers in giving their returns. Cocaine is very largely employed here and abroad, yet only a few cases are reported to us. In the same way nitrous oxide, which must be used very many thousands of times each year, is represented by a report of 227 cases. No dental hospitals sent any full returns to THE LANCET, so that the trivial numbers given should be ignored.

Table C requires no detailed description. It affords information, general rather than exact, concerning the use of the various anæsthetics abroad. The returns from the Continent were very inadequate; thus no ether cases are returned from Switzerland or Germany, although a large number are given in Gurlt's statistics.

In Tables D and Dp are given a list of the "untoward" cases returned from the various hospitals (Series C-I), arranged so as to show their proportion in different hospitals, and, secondly (Table Dp), the proportion of untoward cases occurring under various anæsthetics. In many cases the returns were given generally as "several," no precise figures being offered.

TABLE A A.

Name of hospital.	Nitrous oxide gas followed by ether.	Methylene.	Dichloride of ethylene.	Nitrous oxide gas.	Mixture of chloroform and amyl nitrite.	Successions of chloroform followed by ether.	Ether followed by chloroform.	Mixture of chloroform and ether.
Cancer Hospital	634	15	—	—	—	—	210	—
Ashton-under-Lyne District Infirmary	—	2	—	—	—	—	—	—
St. Bartholomew's Hospital, Chatham	—	—	—	—	—	28	—	—
Bolton Infirmary	—	2	—	—	—	8	—	—
Bury Hospital (Lancashire)	—	1	—	—	—	—	—	—
Cardiff Infirmary	—	—	—	—	—	—	—	52
Derbyshire General Infirmary	—	—	—	—	—	18	—	—
Doncaster General Infirmary	—	—	—	—	—	—	—	13
North-East London Hospital	—	—	—	—	—	—	—	2
Ophthalmic Hospital, Madras	—	23	14	—	—	—	—	—
Ophthalmic Hospital, Moorfields	—	—	—	—	—	—	—	3646
Royston Hospital	—	—	—	—	—	—	—	200
Salisbury Infirmary... ..	50	108	—	28	—	—	—	—
Salop Eye, Ear, and Throat Hospital	—	—	—	—	100	—	—	—
Samaritan Hospital for Women (Belfast)	—	60	—	—	—	—	—	—
Sheffield Children's Hospital	—	—	—	50	—	—	—	—
Sussex County Hospital	—	81	—	85	—	—	—	—
Victoria Infirmary, Northwich	—	—	—	64	—	—	—	—
Western Kentucky Lunatic Hospital	—	441	—	—	—	—	—	—
Westminster Hospital	24	—	—	—	—	—	25	—
Krakow Hospital	—	—	—	—	—	—	—	Billroth's 1600
Bonn Klinik Bostock	—	—	—	—	—	—	6050	—
Totals	708	733	14	227	100	64	6285	5513

TABLE B.—TOTAL OF COMPARATIVE NUMBER OF TIMES DIFFERENT ANÆSTHETICS HAVE BEEN GIVEN.

Other mixtures.	Chloroform	64,693	Other anæsthetics.	Biehl. methylene	677	921
	Ether	9,695		Nitrous oxide	227	
	A.C.E.	1,165		Ethylene Chloride	14	
	ChCl ₃ and ether	15		Cocaine	3	
	Ether and ChCl ₃	3898		ChCl ₃ , followed by ether	8285	
	Nitrous oxide and ether	708		ChCl ₃ , followed by ether, or vice versa	46	
	Chloro-anyl	100	6,321	(Not specified)	61	8400
	Billroth's mixture	1600				

TABLE C.—TABLE SHOWING FREQUENCY OF THE USE OF ANÆSTHETICS IN VARIOUS COUNTRIES.

—	ChCl ₃ .	Ether.	A.C.E.	ChCl ₃ and E.	E. and ChCl ₃ .	Nitrous ox. and E.	Billroth's mixture.	Chloro-amyl.	Bichl. meth.	Nitr. oxide.	Cocaine.	Ethidene chloride.	ChCl ₃ followed by ether.	E. followed by ChCl ₃ .	ChCl ₃ followed by E. or <i>vice versa</i> .	Name of anæsthetic after-nated not given.
England	22,596	5746	740	15	3846	708	—	100	594	227	—	—	8	235	46	61
Wales... ..	252	316	—	—	52	—	—	—	—	—	—	—	—	—	—	—
Scotland	10,994	222	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ireland	2,645	60	420	—	—	—	—	—	60	—	—	—	—	—	—	—
France	560	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Germany and Switzerland ...	18,700	—	—	—	—	—	—	—	—	—	—	—	—	8050	—	—
Poland	—	—	—	—	—	—	1600	—	—	—	—	—	—	—	—	—
India	4,156	—	—	—	—	—	—	—	23	—	—	14	—	—	—	—
Burmah	150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
China... ..	800	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Australia	359	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
United States ...	3,049	3138	2	—	—	—	—	—	—	—	—	—	—	—	—	—
(No name given)	442	662	—	—	—	—	—	—	—	—	3	—	—	—	—	—

TABLE D.—HOSPITALS.—RELATIVE NUMBER OF UNTOWARD CASES UNDER THE DIFFERENT ANÆSTHETICS, WITH TOTALS.

Name of hospital.	Chloroform.	Ether.	A.C.E.	Other mixtures.	Other anæsthetics	Total.
Hospital for Sick Children, Brisbane, Queensland ...	1	—	—	—	—	1
Derbyshire General Hospital	2	—	—	—	—	2
General Infirmary and Dispensary, Blackburn ...	Several (? No.)	—	—	—	—	—
Goculdass Tejpal Native General Hospital, Bomhay ...	Several (? No.)	—	—	—	—	—
Kent and Canterbury County Hospital	—	1	—	—	—	1
Lancaster Infirmary	Several (? No.)	—	—	—	—	—
County South Infirmary	4	—	—	—	—	4
Miller Hospital and Royal Kent Dispensary... ..	1	—	1	—	—	2
North-Eastern Hospital for Children, Hackney-road, E. ...	—	—	—	—	—	—
Reigate and Redhill Cottage Hospital... ..	—	—	2	—	—	2
Roscommon County Infirmary	*1	—	*1	—	—	2
Royal Infirmary, Glasgow:						
Dr. Dunlop Wards, 15, 23, 24	—	2	—	—	—	2
Royston Hospital	—	—	—	Ether and chloroform 2	—	2
St. Saviour's Union Infirmary, East Dulwich Grove ...	6	†2	—	—	Chlor-amyl 2	8
Salop Eye, Ear and Throat Hospital	—	—	—	—	—	2
Sussex County Hospital, Brighton	3	—	2	—	—	5
Tunbridge Wells Eye and Ear Hospital	3	1	—	—	—	4
United States Marine Hospital, Boston, Mass. ...	—	6	—	—	—	6
Hospitals for Insane, Melbourne, Victoria:						
Yarra Bend Asylum	—	—	1	—	—	1
Hospital for Women, Nottingham	A few cases (? No.)	—	—	—	—	—
Continental Hospitals:						
Chirurgische Klinik in Krakau	—	—	—	Billroth's mixture 1	—	1
Clinique Chirurgicale de l'école de Médecine de Toulouse	3	—	—	—	—	3
Totals	24	12	7	3	2	48

TABLE D D.—UNTOWARD CASES.

Chloroform	24
Ether	12
A.C.E.	7
Ether and ChCl ₃	2
Billroth's Mixture	1
Chlor-amyl	2
Total	48

* In same patient at four days' interval.

† In same patient on separate occasions.

SERIES C, II.

STATISTICS FROM PRIVATE PRACTICE.

In response to the Inquiry Forms sent out by THE LANCET, much valuable information was obtained bearing upon (1) the frequency with which the various anæsthetics are used in private practice; (2) the methods most in vogue; (3) the kind of operations undertaken; (4) the deaths under the anæsthetics; (5) the "untoward cases" met with under the anæsthetic. As the names of those who supplied the information were given in confidence, they have been replaced by numbers.

No.	Anæsthetic and method used.	Average number of cases per annum.	Kind of operations for which used.	Number of deaths.	Number of dangerous cases.
1	Chloroform (on lint).	—	—	—	—
2	" " " "	240	Ligature of external iliac.	...	1
	Ether (Clover).	20	Surgical cases.	...	No casualties; several times seen respiration stop; has rallied patient.
3	Chloroform (on lint).	...	Midwifery.	—	—
	Chloroform (Clover's inhaler).	45	Ovariectomy (pelvic), midwifery.	...	More than one case.
	Methylene (Junker's inhaler).	—	—	—	—
4	Chloroform (lint).	117	General operations.	—	—
	A.C.E.	...	For wound of serotum.	...	2
	Chloroform.	...	Circumcision.	...	—
5	Chloroform (Skinner's frame or lint).	50	General and midwifery.	—	—
	Chloroform (Skinner's frame).	...	Removal of dead foetus.	...	—
	" " " "	...	Scirrhus of breast.	...	—
	" " " "	...	Pus in joint.	...	8
	" " " "	...	Fibroma of uterus.	...	—
	" " " "	...	Ruptured gall-bladder.	...	—
	" " " "	...	Cripple (amputation).	...	—
6	Chloroform (on towel).	400	Operations on children.	—	—
	" " " "	...	Circumcision.	...	More than one (infants and old man).
	" " " "	...	Amputation of Penis.	...	—
7	Chloroform or A.C.E. (Stevens' inhaler).	?	Removal of tumour of breast.	...	2
	Chloroform (Stevens' inhaler).	...	Foot torn off by machinery.	...	—
8	" Chloroform (on lint).	?	—	—	—
	" " " "	...	Diseased bone.	—	—
9	Chloroform (Skinner's inhaler).	280	—	—	—
	Ether (Clover's inhaler).	...	.....	...	.....
	Bichloride of methylene (Junker's inhaler).	...	.....	...	.....
	Ether (Clover's inhaler).	...	.....	...	2
	" " " "	...	Amputation of gangrenous toe.	1	—
10	Chloroform.	...	.....	...	—
	Chloroform (Skinner's inhaler or towel).	1882-82, 500;	Midwifery, reducing dislocations.	...	1
	Chloroform (towel).	subse-	Sounding for stone.	—	—
	Chloroform (Skinner's inhaler).	quently 25.	—	—	—
	Chloroform (towel).	...	Removal of carious finger.	1	—
	Methylene. ? method.	50	General operations.	...	Several cases.
	" " " "	...	Ovariectomy.	...	—
12	Chloroform $\frac{3}{4}$; Ether $\frac{1}{4}$.	26	—	—	—
	Chloroform and ether (folded napkin).	...	Midwifery (forceps).	...	1
13	Chloroform (Skinner's inhaler).	?	Dentistry and minor operations.	...	—
	" " " "	...	Forcible catheterism for urethral stricture.	1	—
14	Chloroform or A.C.E. [sometimes] (handkerchief).	35	Chiefly midwifery.	—	—
	Chloroform (on handkerchief).	...	? For tumour.	...	1
	" " " "	...	"	...	6
	" " " "	...	.....	...	2
	" " " "	...	.....	...	Several other cases.
	" " " "	...	.....	...	(Number not given)
15	Chloroform (towel and mask).	12	Midwifery and minor operations.	—	—
	Chloroform.	...	Removal of fatty tumour.	...	—
	Chloroform (on towel).	...	?	...	More than one.
	Chloroform (wire inhaler with flannel).	50	Amputations and dislocations.	—	—
16	Chloroform (Skinner's mask).	...	For phimosis.	...	1
17	Ether (Clover's), Chloroform (lint).	150	General operations.	...	—
	Chloroform (on lint).	...	Exploratory examination of hip disease.	...	2
18	Ether with nitrous oxide (Clover's inhaler).	400	Midwifery and abdominal sections.	—	—
	Ether (Clover's inhaler).	...	Removal of large thyroid.	2	—
	Gas and ether.	...	Lumbar colotomy.	...	—
	Ether (Clover's inhaler).	...	.....	...	A few.
19	Ether (Clover's apparatus).	62	General operations and teeth extractions.	...	Several cases.
	Chloroform.	—	—	—	—
20	Chloroform (handkerchief or felt cone).	30	General operations and midwifery.	—	—
21	Chloroform (on lint).	20	Midwifery and general operations.	—	—
22	Chloroform (Junker and lint).	45	Dental midwifery (occasionally) and general operations.	—	—
23	Chloroform (on lint).	400	Ophthalmic operations.	—	—
	" " " "	...	?	...	Several.
	" " " "	...	Entropion.	1	—
24	Chloroform (handkerchief).	60 or 70	Midwifery and small operations.	—	—
	Chloroform and methylic alcohol.	...	Teeth extracted.	...	1
25	Chloroform (Junker's inhaler).	...	Midwifery, surgical, dental.	—	—
	Chloroform (Snow's inhaler).	...	For necrosis of tibia.	...	1

STATISTICS FROM PRIVATE PRACTICE—continued.

No.	Anæsthetic and method used.	Average number of cases per annum.	Kind of operations for which used.	Number of deaths.	Number of dangerous cases.
26	A.C.E. mixture (Skinner's inhaler).	...	Midwifery (rarely), <i>never</i> for dislocations, reduction of fractures, &c.	—	—
	Chloroform (on lint).	...	Tenotomy for strabismus.	...	3
	" "	...	Scirrhus of breast.	...	
	" "	...	For cancer of breast.	...	
27	Ether (Clover's inhaler).	65	General operations.	—	—
	Chloroform (lint).	...	Blind fistula.	...	1
28	Ether at first, then chloroform.	...	Midwifery; general operations.	—	—
	Chloroform (handkerchief or lint).	25	For hæmorrhoids.	...	1
	Chloroform (on lint).	...	All cases needing it; parturitions.	...	A few cases; No. not given
29	Chloroform or nitrous oxide (lint).	175	.....	...
	" "	...	Midwifery and general operations.	...	
30	Chloroform [children] (cone); A.C.E. [adults] (cone)	200	For vascular growth of urethra.	...	2
	A.C.E. mixture (in cone).	...	Hæmorrhoids.	...	
	" "	...	Gynæcological.	...	
31	Chloroform and ether; chloroform (pulmonary or renal disease).	750	Gynæcological.	2	—
	Methylene.	...	.....		—
	Ether (Ormsby's inhaler).	...	Gynæcological.		—
32	Chloroform.	...	For removal of sloughing fibroid.	1	—
	Ether.	...	Surgical operations (minor).	1	—
33	Ether (Clover's inhaler).	100	Dislocations of shoulder.	—	—
	Chloroform (Skinner's inhaler).	...	Surgical cases.	1	—
34	Ether (Clover's inhaler).	...	Strangling hernia.	1	—
	" "	...	Removal of sarcoma from side of chest.	1	—
35	" "	...	Excision of jaw.	1	—
	Ether (anorpha).	...	General operations.	—	—
36	Ether (Clover's smaller inhaler).	300	Amputation of finger.	1	—
	Chloroform.	...	Nævus (infant's head).	—	—
37	" "	...	Surgical.	—	—
38	Ether (Clover's inhaler) for cases over twelve years.	Between 300 and 400.	Midwifery.	—	—
	Chloroform (lint).	...	Forceibly straightening a talipes equinovarus.	...	1
	" "	...	Fracture of leg and wounds on face.	...	1
	" "	...	For re-introduction of catheter into ruptured urethra.	...	1
	" "	...	For abscess in mouth with carious tooth.	...	1
	Ether (Clover's smaller inhaler).	...	For opening pyæmic abscess in shoulder-joint.	...	1
	" " " "	...	All kinds of midwifery.	...	—
39	Chloroform.	271	Tracheotomy for cancer of larynx.	1	—
	Chloroform (wire frame).	—	Pyothorax.	1	—
40	Chloroform.	...	Cystotomy, for cystitis due to bilharzia hæmatobia.	1	1
	" "	...	General operations, occasionally midwifery.	—	—
41	Chloroform (on towel).	20 (about).	Pain from stone in ureter (drunkard).	1	—
	" "	...	Puerperal convulsions.	1	—
42	Chloroform (Skinner's mask), rarely.	20	Midwifery.	...	None.
	Ether (cone or towel), more often.	—	General operations.	—	—
	Ether and chloroform (Clover's smaller apparatus), usually (4 pts. to 1 pt.).	...	Strangulated umbilical hernia, severe.	1	—
	Ether and chloroform (4 pts. to 1 pt.).	—	General operations and teeth.	—	—
43	Methylene (leather case with towel).	61	Pyæmia.	1	—
	Chloroform.	...	.....	...	2 (about).
44	Methylene (leather case with towel).	...	General operations and midwifery.	...	—
	A.C.E., 1, 2, 3 parts (folded lint).	50 to 100	.....	...	1
	(?)	...	Midwifery and operations, important and minor.	—	—
45	Chloroform (towel or handkerchief).	300	.....	...	A very few (number not given).
46	Chloroform (towel or handkerchief).	...	Surgical operations, reduction of dislocations, hernia, midwifery, and for diagnosis in abdominal conditions.	—	
47	Chloroform (twenty years) (flannel over frame).	...	(?)	...	
	A.C.E. mixture (flannel over frame).	...	(?)	...	2
	Ether (Clover's inhaler), sometimes.	...	(?)	...	
48	Chloroform.	...	(?)	...	
	A.C.E. mixture.	...	(?)	...	General (number not given).
	(?)	...	(?)	...	
49	Chloroform (Lister's method, towel).	16	General operations.	—	

* Danger due to secondary causes rather than to anæsthetic.

STATISTICS FROM PRIVATE PRACTICE—continued.

No.	Anæsthetic and method used.	Average number of cases per annum.	Kind of operations for which used.	Number of deaths.	Number of dangerous cases.
50	Chloroform (towel).	...	External nrethrotomy.	1	—
51	Chloroform (towel or mask of lint).	...	(?)	...	6
52	Chloroform (lint or frame with flannel).	...	All cases, except midwifery.	—	—
	Ether (Clover's inhaler).	—	—	—	—
53	Chloroform (towel and Skinner's inhaler).	25	General operations and midwifery.	—	—
	A.C.E. mixture (muzzle inhaler).	—	—	—	—
54	Ether and chloroform [equal parts] (on towel).	15	General operations and midwifery.	—	—
55	Quibb's ether and chloroform (open-wove flannel on frame).	200	General surgery, obstetrics and gynaecology.	—	—
56	Ether (cone).	100	General surgery and midwifery.	—	—
	" "	...	(?)	...	Patient etherises badly whenever obstructive dyspnoea is present.
57	Chloroform and ether [equal parts] (lint and cone).	50	Tooth extraction and midwifery.	—	—
58	Chloroform (cone-shaped towel).	50	Surgical, dental and obstetrics.	—	—
59	Chloroform (towel).	...	Extraction of teeth.	...	Some (number not given).
60	Chlor. form (towel folded or single).	100	General operations.	—	—
61	Chloroform (handkerchief).	...	Minor operations and midwifery.	—	—
	Ether (cone and towel).	...	Surgical cases.	—	—
62	Ether (towel cone).	...	Removal of ovarian cyst without adhesions.	1	—
63	Cocaine.	...	Eye operations: small growths.	—	—
	Chloroform (towel or handkerchief).	130	Circumcision, rectal and uterine polypi, hæmorrhoids, teeth, tracheotomy, pharyngeal growths, abscesses, dilatation of cervical canals, rectal ulcers, hare-lip, &c.	—	—
	Chloroform (on towel).	...	Circumcision.	...	2
	Chloroform (on handkerchief).	...	Dilatation of cervical canal.	...	
64	Chloroform (folded napkin).	(?)	.....	—	—
	Ether.	...	Failure of heart } Midwifery.	—	—
	Chloroform (on napkin).	...	For cataract.	...	2
	Methylated chloroform (on napkin).	...	For reduction of dislocation.	...	
65	Chloroform (sponge in cage with mouthpiece).	220, 1850-52. 15 since 1852.	General cases and midwifery.	—	—
66	Chloroform (folded handkerchief, Junker's inhaler, lint).	150	All surgical operations except cataract and iridectomy: midwifery three times.	—	—
	Chloroform (Junker's inhaler).	...	Removal of enlarged and ulcerated serofulous glands of neck.	...	1
	Chloroform (folded lint).	...	Lateral lithotomy.	...	1
	Chloroform (Junker's inhaler).	...	Excision of epithelial cancer from lip.	...	1
	" " "	...	Operations and midwifery.	—	—
67	Chloroform (towel or lint).	6	General operations; midwifery (occasional).	—	—
68	Chloroform (towel or small flannel inhaler).	20	For opening knee-joint for acute suppuration.	...	1
69	Chloroform.	...	Midwifery, diseases of women, laparotomies, &c.	—	—
70	Chloroform (Esmarch's inhaler).	300	Fistula in auro.	...	1
	" " "	...	(?)	...	Others less serious (number not given).
	" " "	...	(?)	...	—
71	Chloroform <i>only</i> (small towel).	300	General surgery, all cases operated.	—	—
72	Chloroform (small towel).	...	(?)	...	4
73	Chloroform (on towel held over face so as to allow administrator to see face without removing towel).	(?)	All cases; midwifery (instrumental labours).	—	—
74	Chloroform (towel).	...	For exploratory incision and removal of sarcomatous facial tumour.	1	—
75	Chloroform (folded lint or on lint expanded in wire).	129	All major operations.	—	—
	Cocaine [eye cases].	—	—	—	—
	Chloroform (lint).	...	Amputation (large).	...	4
	" "	...	Large tumour of jaw.	...	
	" "	...	Lithotomy.	...	
	" "	...	Tumour of jaw.	...	
76	Chloroform, generally with morphia hypodermically (formerly cup inhaler, now flannel on wire frame; Junker's apparatus [midwifery]).	500 (formerly). 100 (now).	Surgical operations and midwifery.	—	—
	Chloroform.	...	(?)	...	Several cases.
77	Chloroform (formerly).	12	—	—	—
	A.C.E. mixture (cone of spongiopiline, lint inside).	—	—	—	—
	Chloroform (cone with lint in it).	...	Reduction of dislocation of little finger.	...	1
78	Chloroform (handkerchief or lint).	...	General operations and instrumental midwifery.	—	—

STATISTICS FROM PRIVATE PRACTICE—continued.

No.	Anæsthetic and method used.	Average number of cases per annum.	Kind of operations for which used.	Number of deaths.	Number of dangerous cases.
79	Chloroform (Skinner's inhaler).	160	General operations and midwifery.	—	—
80	Ether [occasionally] (Clover's apparatus).	—	—	—	—
81	A.C.E. mixture (folded napkin).	45	General operations chiefly.	—	—
81	Ether } American inhaler.	55	Reduction of dislocations, excisions, midwifery.	—	—
82	Chloroform [midwifery] } Chloroform (handkerchief), and giving patient plenty of air.	4	General operations and midwifery.	—	—
83	(?)	...	.....	...	Several cases.
84	Chloroform (napkin or handkerchief).	6	Midwifery and minor operations.	—	—
85	Ether (Ormsby's inhaler).	75	Midwifery, simple and capital operations; abdominal sections.	—	—
86	Chloroform [midwifery] (Ormsby's inhaler).	—	—	—	—
	Chloroform [1867-72] (wire mask).	—	—	—	—
	Ether [1873-89] (cone towel).	70	—	—	—
	Ether and chloroform (4 parts to 1 part).	—	—	—	—
	[1886-89] (Clover's small inhaler).	—	—	—	—
	Chloroform (wire mask).	...	Removal of hæmorrhoids.	...	1
	" " "	...	Removal of breast.	...	2

The deaths reported in the foregoing tables (Series C-II.) amount to 11 under chloroform and 7 under ether, 3 under methylene, and 1 under another mixture (ether 4, chloroform 1). We are further told that 71 more or less dangerous cases occurred under chloroform, but death was avoided—in 3 when ether was given, in 2 when ether was first given and chloroform afterwards, and in 5 when the A.C.E. mixture was employed; and some of the observers speak of "several" cases of danger under chloroform and "several" under ether. Chloroform appears to be most frequently employed in general practice.

CAUSES OF DEATHS UNDER ANÆSTHETICS.

It would, therefore, appear that in England and Wales chloroform is responsible for a larger number of deaths and of dangerous cases than is ether. In India, and the Tropics generally, ether is not used, and chloroform is very largely employed, with a very low death-rate. On the Continent the death-rate is in favour of ether, but it is at present difficult to gauge the relative frequency with which the two substances are employed. In the United States ether is widely used, but here again we cannot with sufficient accuracy to draw conclusions estimate the number of times that anæsthetics in general and chloroform in particular are used. In Scotland, as we have above stated, there is no reliable evidence of how many deaths under chloroform really occur, although it is believed that deaths are fairly frequent. What, then, are the causes of such deaths? It has been pointed out above that a considerable number of deaths occurring when chloroform or when ether is employed are quite unpreventable, as in Cases 128, 233, 274, and that many others are undoubtedly due to inexpert administration leading to over-dosage; but of the residuum what information can be gained as to the manner of the dying and the prevention of fatalities?

Of the usually assigned predisposing causes of death under anæsthetics our records appear to us to demonstrate that chronic alcoholism, cancerous cachexia, emphysema, chronic renal disease, and cardiac valvular disease cannot be regarded as playing any important part. Fatty changes in the heart substance are frequently reported in the necropsies we have published, but it must be remembered that these are, as a rule, merely the register of a generally deteriorated and depreciated organism.

THE DETERMINING CAUSES OF DEATH UNDER CHLOROFORM.

The larger proportion of deaths are reported as having resulted from initial heart failure, in opposition to the view to which the physiological researches of the Hyderabad Commission have led. That these conflicting views are reconcilable seems to us to be possible, at least in many cases. The reporters of numerous cases refer to *failure of the pulse* as occurring before that of respiration, and it is undoubtedly true that, although the pulse does fail, yet the actual heart action continues for some time after pulse failure. This explanation, however, seems hardly to apply to those cases of *sudden death* which occur at the commencement of chloroform anæsthesia, nor can these deaths be explained, as is pointed out above, as being due to fright and not to the anæsthetic. The view enunciated by the committee of the Royal Medical and Chirurgical Society is thus expressed: "The strongest doses of chloroform vapour, when admitted freely into the lungs, destroy animal life by arresting the action of the heart."³ And again: "By moderate doses of chloroform the heart's action is much weakened for some time before death ensues; respiration generally, but not invariably, ceases before the action of the heart, and death is due both to the failure of the heart's action and to that of the respiratory function."⁴

Of the causes of death under the various anæsthetics considered above, the most frequent under chloroform would appear to be poisoning of the medullary centres. In some instances this occurred suddenly, and a simultaneous cessation of the respiration and circulation took place. In others death arose from primary impairment of the circulation, while in still others respiratory paralysis was the first thing

noticed. Under ether the commonest mode of death was from mechanical or other interference with inspiration leading to asphyxia. The initial heart failure reported to have occurred under chloroform was not reported under ether.

The deaths under nitrous oxide gas were mostly due to causes other than the anæsthetic. In some few cases the condition of the patient at the time of the administration appears to have contributed mainly in bringing about the fatal result.

With regard to the other anæsthetics, their behaviour, judged by the clinical evidence before us, was much the same as that of chloroform.

When the wide differences in the methods adopted in giving the anæsthetic are considered there seems little to be said in favour of one method over another, provided the all-important condition of due dilution of the chloroform vapour is insisted upon. However, dropping chloroform upon lint, when done carelessly and at haphazard, as appears to have occurred in some cases reported, is undoubtedly dangerous. To achieve this dilution, probably no better plan can be adopted than that of using a simple linen cap, such as Surgeon-Lieutenant-Colonel Lawrie has employed with such success, or the use of some apparatus capable of regulating the quantity of chloroform and of air taken by the patient. The main point forced upon us is, we submit, that more depends upon the person giving the anæsthetic than upon the method he adopts.

These remarks do not, however, apply with equal force to ether in its exhibition, owing to the lighter character of its vapour. The causation of deaths from ether is, as pointed out above, in by far the majority of cases asphyxial and due either to careless administration or to mechanical obstruction to respiration—e.g., mucus, mucus, &c—or more rarely to paralysis of the respiratory centre in obstructive pulmonary conditions. Ether should be given with the utmost caution, and in comparatively small quantity. There is evidence that such was not always the plan adopted, so that some at least of these deaths were due to imperfections in the use of the anæsthetic. Experience since the formulation of the Royal Medical and Chirurgical Society's report (1864) has shown that the use of an open method—the employment of a towel, or cone, or sponge—is not the best plan of using ether. When one of the modern inhalers is skilfully used, although deaths are few, yet they occur both immediately and remotely. Of the former we have already spoken; as to the latter, it is noticeable that in the necropsies after deaths from ether the lesions revealed are not, as a rule, those which are generally said to be associated with ether toxæmia—viz., pulmonary and renal diseases.

It lies outside the province of the present Report to theorise or to attempt to reconcile the teaching of physiological research with clinical observation, but it may here be indicated that very valuable evidence is presented to us by the cases above cited upon the points which have been, and perhaps still are, under open debate amongst both physiologists and clinicians. The strength of the vapour of chloroform determines very largely the manifestations of the phenomena attendant upon the inception of danger, or ultimate death from that cause. Thus, in many cases, "deep gasps" are described, which undoubtedly led to the intaking of an overdose, and sudden cessation of cardiac and respiratory action followed an overpowering dose given as a concentrated vapour, even although the actual quantity taken was small (*cf.* Case 159).

In other cases "struggling" led to the same peril, as well as the additional one of the imposition of a severe strain upon the heart by fixation of the chest walls, and muscular pressure upon the systemic veins (*cf.* Cases 19, 23, 25, 43, &c.).

In other cases a warning seems to have been given by "stertorous breathing" (*cf.* Cases 24, 44, 53, 61, 71, 77, &c.), and these appear to belong to the class in which a slightly too high percentage of vapour is inhaled, or, what amounts to the same thing, the expiration of the chloroform [output from the blood] was hampered, while the inspiration was continued.

In connexion with many of the cases reported above, the following extract from the Royal Medical and Chirurgical Society's Report, from which we have already quoted, puts the matter very plainly. It is said: "..... it must not be supposed that in all the cases of death by syncope a percentage of the chloroform vapour had been administered which was inevitably dangerous. In the experiments upon animals some died by syncope while inhaling much diluted

³ Report of the Committee appointed by the Royal Medical and Chirurgical Society, p. 28. London: Adlard. 1864.

⁴ *Ibid.*

vapour, and in every case the force of the heart's action was much reduced for some time before death. If, as usually happened in the experiments on animals with the diluted chloroform vapour, the respiration gradually failed, whilst the heart continued to beat with appreciable force, this constituted a sufficient warning of approaching death, and upon the withdrawal of the vapour recovery at once ensued. Few if any deaths have taken place in this manner in the human subject."

"If, on the other hand (as sometimes, but rarely, happened), there was sudden failure of the heart's action, the breathing still continuing, death supervened, practically without warning. This mode of death, which was exceptional in the experiments on animals, is the most frequent in the human subject." The experience of the Hyderabad Commission gave no evidence of this form of death in their experiments upon the lower animals, and Surgeon-Lieutenant-Colonel Lawrie had not in his Indian practice met with an instance among human beings. In the cases we have reported it would appear that such deaths do really occur in temperate countries and with frequency.

The evidence in favour of heart failure occurring under ether seems to us to be unsatisfactory, for, when syncope is said to have occurred, it appears that the violence of the struggling was sufficient to have led mechanically to heart failure.

As to death occurring during partial anaesthesia from surgical shock we submit there is much evidence in the cases we have cited above to prove that such an accident is frequent and occurs alike under chloroform, under ether, and under nitrous oxide.

A careful study of the cases shows that both under chloroform, ether, nitrous oxide, and other agents, several deaths have resulted from the operation having been commenced before complete anaesthesia had been obtained, or when the patient was allowed to resume consciousness before the operation was completed (*cf.* Cases 23, 50, 66, 166, and many others).

The grave dangers of allowing respiration to be hampered during the administration of an anaesthetic are shown in cases of postures other than the supine, changing of posture from the supine, in empyema, and other causes (*cf.* Cases 36, 154, 200, 454, 472, 474, 480).

The consideration of the nature of the operation in progress when death from an anaesthetic occurred goes to show, it is believed, that the gravity of the surgical procedure is by no means a criterion of the amount of danger as far as the anaesthetic is concerned. In the larger number of fatalities the operation was of a trifling nature, and this fact suggests the possibility, in some of this number, of less care and precaution, and individual attention to the anaesthetic, than are associated with the graver operative procedures.

It has long been held and taught that parturient women and young children were almost exempt from the perils of chloroform, but the reports before us, and those supplied by the tables derived from medical men in private practice, appear to negative this supposed immunity.

It might be hoped that the large amount of information afforded by our reports on the subject of measures adopted for resuscitation would enable us to indicate some very definite and hopeful measures the adoption of which would render the chances of reviving animation at least probable. In this we are disappointed. The measures adopted in the "untoward cases" appear to have been followed out in the fatal ones. The Report of the Hyderabad Commission, as well as that of the Committee of the Royal Medical and Chirurgical Society, have insisted that the chance of resuscitation depends upon the promptitude with which the restorative measures are adopted. Possibly herein, in some

instances at least, lies the reason of success in one case and of failure in another. The result may depend upon an earlier appreciation of danger and greater celerity in adopting measures for resuscitation. It should be remembered that even the best restorative measures are dangerous unless wisely applied. Probably artificial respiration by the combined methods of Silvester and Howard with the usual cardiac stimulants (when any concurrent heart failure exists) are the only measures which need be adopted in ordinary cases of chloroform overdosage. Inversion when circulatory weakness exists appears to be valuable, but to be dangerous in all asphyxial conditions. With regard to the employment of the various alkaloids or sedatives in conjunction with the general anaesthetics, it is felt that sufficient evidence has not been placed at the disposal of THE LANCET for the matter to be dealt with in this Report. The employment of morphine in combination with chloroform, which Surgeon-Lieutenant-Colonel Lawrie has found of value, is lauded by many, but, on the other hand, there are others who have found respiratory dangers to be more frequent when morphine is used.

Cocaine, &c.—It has been found quite impossible to deal with the various materials used in the production of local anaesthesia, and although there have been received numerous reports of deaths under cocaine they have for the above reason been omitted.

With regard to the various mixtures of general anaesthetics it must be admitted that, with perhaps the exception of the A.C.E. mixture, their use is so exceptional that there is insufficient evidence in their favour to warrant any general commendation or the reverse. Of nitrous oxide but few cases of deaths or dangers are reported, and when it is remembered that this anaesthetic is used more frequently than any other, with fewer precautions, and as a rule with no special preparation of the patient as regard food, &c., its safety seems to be amply proved. Indeed, an examination of the reported deaths shows that the gas could hardly have been held responsible for them. As, however, shock plays so important a part in the causation of deaths under anaesthetics, it is most important that full anaesthesia be obtained when this as when other agents are employed.

Of the other anaesthetics comprised in this Report little need be said; the mortality under them is too high for their use, under present conditions, to be recommended.

In conclusion, we subjoin the following deductions which Dr. Dudley Buxton thinks may be drawn from the Report:

1. That the death-rate under anaesthetics heretofore has been unduly high, and may, by improved methods and greater care, be lowered.
2. That ether when properly given from an inhaler, permitting graduation of the strength of the vapour, is the safest anaesthetic in temperate climes for general surgery.
3. That nitrous oxide gas should be employed for minor surgery, and should replace chloroform in dental surgery.
4. That chloroform, when given by a carefully trained person, is a comparatively safe body, but is not in any case wholly devoid of risk.
5. That no age or nation is free from danger under anaesthetics.
6. That the perils of anaesthetics, however slight, demand that the undivided attention of a duly qualified and trained medical man should be given to the administration of the anaesthetic.



